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MEN OF SCIENCE AND HIGHER EDUCATION IN A DEMOCRACY *

OTTO BLÜH, PH.D.

Research Fellow, University of Birmingham, Formerly Lecturer in Physics, University of Prague

Editor's Note: Do our scientists exhibit the scientific attitude when they become so enthusiastic that they see no limitations in science? Or do they weigh both the potentialities and limitations? Dr. Blüh gives a challenging analysis in this article. A companion article relating to the applications of his generalizations to the teaching of physics will be found in the December issue of The American Journal of Physics.

Some of the ideas expressed by Dr. Blüh are not "necessarily the ideas of" this educational station. It is hoped that we will receive for publication rejoinders to the views presented in the article.

INTRODUCTION

In the midst of a great war the thoughts of many are already directed towards reconstruction. Visible signs of the horror of warfare, destroyed cities and villages, suggest rebuilding in better and more beautiful shape. Less visible, but not less fatal are the destruction and neglect of cultural values and education. These too are waiting for restoration in a more perfect form when the physical and intellectual black-out over Europe is lifted.

The master-word of reconstruction is planning. The democratic countries have had to learn from their foes first of all the planning of war work, in order to be capable of exerting the full strength of their resources, and with the united constructive efforts of their citizens to withstand the assault of the enemy. Planning the war machine, supply, politics, economics, culture, and education is the demand of the hour.

* The author gratefully acknowledges extensive and helpful editing of the manuscript by Professor Lloyd W. Taylor of Oberlin College.

There are many who contemplate for the time after the war the rise of an ethical liberalism, based on the supreme maxim of the equal worth of each individual, which has suffered a temporary eclipse through the overvaluation of mass and race. As this maxim appeals only to the ethical consciousness of the individual an authority is necessary to make the concept effective in a wider community.

The liberal state in its original form was established to liberate the individual from the mediaeval powers, such as princes, dignitaries, estates of the realm, corporations, guilds, but it did not make him wholly independent of minor political and of economic powers, the political parties, churches, sects, lodges, exploiters, trade unions, *et cetera*, to which the citizen, according to his social class, has to bow or from which he has to ask assistance. Paradoxically, in respect of making the citizen dependent only on *one* superior power, that of the state, the modern totalitarian state has its roots in the idea of the liberal state, and it is therefore not by

accident that the two nations, in which the idea of liberalism was understood in the way argued above welcomed the rise of one party to power and its identification with the state. So the liberal state in the form which it necessarily must have in modern society involves the real danger that its planned organization may easily become converted to very different aims in the hands of ambitious men. There is in all human undertakings the tendency that the end may be defeated by the means; this is the risk of any planned reconstructional work as well, and humanity and freedom of thought may be jeopardized if one forgets or neglects the ultimate goal. Have we to renounce planning, or are we prepared to risk intellectual bondage in an all-out attempt to save our liberties?

Many treatises have been written on the political, economic, and ideological causes of the degeneration of the liberal democracies into dictatorial states, but little attention has been paid to the part which men of science and the scientifically educated class played in this evolution.[1] A special cause of the decline of the democracies in Central Europe was certainly the ideology of the *"Stände-staat"* or "state of estates," into which Italian fascism in its first phase seemed to crystalize, and which in Germany and Austria developed from the planned national community of a Rathenau through and beyond the romantic conceptions of Spann to a complete dictatorship. And the exponents of the planned state were the scientifically educated men, the scientific experts! Not only among the great number of educated people, but among men of science the ideology of the state of estates prevailed. No wonder that even democrats in these countries abandoned the belief that democracy was capable of surviving.[2] Fascinated by planning, eager to find a secure place in a new hierachy of society, these men, often unaware of the consequences, paved the way for powers which brought into peril and eventually into decline not only political and intellectual freedom, but the freedom of science itself.

In the remaining democracies some leaders in the natural sciences are today likewise prepared to become exponents of planning, and to take upon themselves the form of a new estate. They have argued before: "Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the material provided by them, . . . It is their duty to assist in the establishment of a rational harmonious social order out of the welter of human conflict, into which the world has been thrown through the prostitution of the rich gifts with which they have endowed the human race." * However, while realizing the results of planning in the hands of scientific experts we are not forthwith prepared to recognize the claim of "science" to be the model for the era of reconstruction. Even if we had the requisite confidence in the individual scientists, we should distrust their assumption that the salvation of humanity is contingent upon man's capacity to understand, in the scientific sense, the forces and factors which he has mobilized and which now control his own behaviour. We ask ourselves rather whether the analytical form of modern scientific reasoning—whether in the natural or the social sciences—with its resolute disregard of values, has not in many instances prepared the way for strong political powers to embark on large-scale doctrinaire experiments in complete disregard of accumulated values worthy to be conserved. Scientific experts, reminded of the planned organization of their own specialized subjects, are by the whole structure of their present education easily inclined to follow authoritarian creeds and to become exponents of planning merely for the sake of planning; and "science," this new doctrine of

[1] Blüh, Otto. *Nature, 147,* 298 (1941).

[2] Mannheim, K. *Man and Society in an Age of Reconstruction* (1940).

* *Nature,* December 28th, 1938, Editorial.

infallibility, covers only too conveniently any considerations and any conclusions which concern the private and public life of man.

We want to show that there is another way open to scientists than to become preponderantly politically minded. This way is co-operation with a new, liberal and humane educational enterprise, the supreme problem of the longed-for state of liberty. The truly liberal state cannot spring into existence in full perfection but will have to be built, perhaps by many generations, and the intervening present cultural planning must, above all, provide for the education of men who not only claim to know the best for their community, or the state, or humanity, but who are also willing to come peaceably to terms with those who interpret this best otherwise. Planning might avoid its inherent danger if its scientifically educated men possessed sufficient breadth, a condition which can scarcely be said to obtain today. Yet unless a system of education is devised which produces a scientifically minded population having the will and the ability to guide our social destiny, demagogues and rabble rousers will continue to hold the balance of power. Men of science must take a large part in the design of such a system of education, but they must be also competent and enthusiastic educators and men of vision.

THE FUNCTION OF THE SCIENTIST

One of the topics which has increasingly interested physicists in recent years is the interrelation between physics and society. The discussion about the social function of science, as this complex of questions is called, had its starting point more or less in physics, or rather in some criticisms which have been raised against physics in its modern form. It may be questioned whether the criticisms were important enough to justify a reaction on the part of the scientists, or whether scientists challenged the charges only in order to have the opportunity of pointing out broadly the significance of their scientific work for our culture. In fact much was said and written about this theme from different angles, and much more will be said and written, we may expect, in the future.

It is rather significant that, in all such discussions the tendency is to speak of the function of science, never of the function of the individual scientist. This trend toward anonymity is as much a characteristic of the pronouncements of men of science as it is of others who undertake to consider the place of "science in society." It is very revealing. It reveals both a tendency on the part of the public to regard science as twentieth century magic and a disinclination on the part of men of science to acknowledge personal responsibility for the problems encountered in that broad field. Both of these attitudes contribute to the present-day frustration of science. Until they are corrected, society will remain as incapable of receiving the contribution which men of science and of vision could make as these men are incapable of making it. It should be the prime responsibility of the educational world to open the channel for this contribution and for scientists to recognize that at least one of their functions in society is an active educational one. Yet notwithstanding the fact that men of science nominally form an important element in the educational world, they characteristically show slight interest in their broader responsibilities as educators and not infrequently resent any attempts to bring these responsibilities to their attention.

There are of course a few men who rightly confine their efforts to "pure" research, but the great majority of educators in the field of science could easily help to bring about the "new and better world" which one may reasonably expect to see when men of science begin to take their responsibility seriously. The academic recluse is to be found also among teachers of non-scientific subjects. In offering only knowledge instead of education the teachers of the humanities also often are subject to

the same temptation as the scientists. Most learned men are today specialists and prefer to be specialists, perhaps because this exonerates them from a troublesome liability; and as teachers they find an excuse for their escape and isolation in a special theory, the theory of Transfer in Education.[3]

THE THEORY OF TRANSFER IN EDUCATION AND CULTURE

Scientists are rather generally convinced that the most important contribution they can make to their pupils and students is to develop their ability to think critically. This conviction is so common as scarcely to require documentation, but two recent studies, one in England and the other in the United States, reflect it explicitly. In a report on the teaching of physics in English secondary schools,[4] A. W. Barton concludes;

> One can learn from science, and perhaps especially well from physics, a sense of fact and a sense of law, two qualities of vital importance to the citizen in modern life, with its dogmas, half truths and propaganda.

On the other side of the Atlantic, in a study prosecuted by a special committee of the American Association for the Advancement of Science,[5, 6] more than a thousand college and university teachers of science answered the following question, among others;

> What do you believe are the most significant contributions which a study of (your science) should make to those students who are not to specialize in it?

More than eighty per cent indicated their belief that the most important contribution was the ability to think critically.

In view of the studies on the nature of the learning process that have been made during the last generation, this is really an astonishing pronouncement. The assumption of transfer of training from one field to another was at the center of educational theory two or three generations ago when the ancient languages and mathemtics declared a virtual monopoly on intellectual training under the name of "formal discipline." Notwithstanding the fact that this theory has been thoroughly discredited, we are apparently seeing the sciences take it over, lock, stock and barrel. So uncritically is it being adopted that one may doubt whether the science teachers realized that they were taking a position on an educational theory at all.

In addition to Simon's article referred to above, the even more recent Spens report[7] establishes the fallacy in the doctrine of transfer. It says at one point;

> It does not follow that, because people have learned to apply logical processes in mathematics, they will think logicaly about politics, nor that, because they have learned to verify facts and to check theories by facts in the physical sciences, they will realize automatically the desirability of this procedure in other fields. Such transfer of training, if any, is very much smaller than teachers and educationists were formerly accustomed to assume.

The deeper reason why so many teachers of science adhere to this educational theory half unconsciously, is, I assume, understandable if we consider that almost all scientists believe that mankind has learned to think critically through science.* The

[3] *Education for Citizenship in Secondary Schools* (1936). Sir Ernest Simon, "The Problem of Transfer."

[4] Barton, A. W. *The Teaching of Physics in Schools* (in Reports on Progress in Physics), *5*, 422 (1938).

[5] Taylor, L. W. *American Journal of Physics, 8*, 41 (1940).

[6] Taylor, L. W. *Science 9*, 560 (1940).

[7] *Report of the Consultative Committee on Secondary Education*, with Special Reference to Grammar Schools and Technical High Schools (1939), pp. xxxviii and 130.

* So e.g. Dewey[8]: "The function which science has to perform in the curriculum is that which it has performed for the race: emancipation from local and temporary incidents of experience, and the opening of intellectual vistas unobserved by the accidents of personal habit and prediction." But has science in the modern sense really performed this function for the race? The theory of transfer in culture will be discussed in a subsequent article.

[8] Dewey, John. *Democracy and Education* (1916).

historians of science make us believe this assumption, and scientists become imbued with it during their studies. The transfer theory in the field of scientific education is therefore only a special case of a wider theory, a theory of *transfer in culture*, which says that scientific work is transferred automatically into human culture, and that not only technical progress, but also intellectual progress was and is advanced primarily by the sciences. Scientists are inclined to think that their work brings about preponderant progress for mankind largely or even solely through the existence of science; that science much more than other spheres of knowledge has moulded our intellectual world, and educates mankind *per se*. This flattering opinion is not only expressed in some presentations of the history of science, it is also being stressed in certain subject-matter fields which desire to be considered scientific. The tendency in recent years to try to apply the methods developed by the sciences to sociology and political science finds its justification in this historical interpretation. This may be right or wrong, but we can state here that one must expect that the theory of transfer in science teaching will be abandoned by scientists only when the wider transfer theory of the sciences in culture is put aside; not before this will scientists successfully treat the educational problem with which they are now confronted.

GENERAL EDUCATION AND SPECIALIZATION

There is a tendency among the subject-matter specialists who dominate the scene at the higher educational levels to be rather indifferent if not hostile to the idea of general or liberal education. This tendency is perhaps less pronounced in the United States than elsewhere, but even there it seems to be fairly general. One may concede immediately that, conceived as a mere conglomerate of incoherent knowledge, as encyclopaedic instruction, general education is rightly rejected. On the other hand one must not forget that a really general education can be achieved only through the pursuit of knowledge in particular fields. The oft-quoted saying of Ellen Key that "Education is what remains when one has forgotten what one has learned" presupposes, what often is overlooked, that one has at least learned something. And it does matter what kind of things one has learned. Learning along the somewhat conventional lines seems not unnecessary, even though an educational anarchist like Ellen Key probably did not believe in it. General education can only be achieved with the help of general instruction, which gives a clear picture of human knowledge, neglecting no subject in favour of another, but emphasizing the share of each in human culture. The selection of the particular subjects most valuable to the time and situation, will always be a subject for controversy. The range is so wide, however, that no single choice is likely to be very crucial.

The difficulties of liberal education lie mainly in the fact of its liberality. Educating to a sharply outlined educational ideal, to a certain belief or a creed, is a relatively easy task compared with designing an education which may at the best recommend a certain conduct in life, but cannot possibly set it up as the demand of an external power. Liberal education of this kind is a very recent concept because it is only possible in a real liberal state and society, which themselves can only be realized through liberal education. This vicious circle can be avoided by flying off on the tangent of authoritarianism but if it is wished to prevent this, and to recognize liberalism as a *processus in infinitum*, the only way that finite beings can approach it is by a process of successive approximations.

It is clear that the question of education leads to political questions, and no educator is well advised if he tries to avoid this problem and to build his plans only on the

lofty ground of pure scientific (which in this connection means psychological) reasoning. The decision, e.g., how to teach physics can only be reached if the teacher has always in mind that the problem—What sort of physics at school?—can only be solved if he answers the question—Physics for what kind of school?—The common assumption that one's own school is more or less perfect, or at least does not necessarily require a change, renders many teachers incapable of participating in any really significant program of improving the educational system.

The neglect of the educational tasks of the liberal state or society (in so far as such a state or society has been yet attained), is due to the belief that everybody understands and rightly estimates liberal institutions, and that no sane man will try to infringe his own liberties. It was not at all a matter of accident that the French National Assembly in 1792 did not accept a plan for the French public educational system prepared by Condorcet, which stated "The aim of education is not to make men admire existing institutions, but to make them able to criticize and to improve them."[9] They preferred to accept the plan of Talleyrand of 1791 which provided merely for the education of specialists. In this plan the general intellectual background of the citizen in the new state of liberty and equality was taken for granted, and to advocate it, or to educate for it, seemed unnecessary. What the state demanded (especially in the state of emergency then existing) was the citizen—specialist, the citizen—scientist, the citizen—teacher, the citizen—official; however, it is significant that it was the Emperor Napoleon who eventually carried out Talleyrand's plan.[10] The fear that the state would never tolerate a liberal education induced the best heads of the German liberal enlightenment of 1800 to try to make the German universities independent of the state; the attempt failed, as we know, but it gave the schools a high degree of freedom under the state. Many years later these ideas fascinated Matthew Arnold,[11] although what he could see in Prussian schools even before 1871 was only a weak reflection of the conceptions of a Wilhelm von Humboldt.

However the modern state needs specialists, so does modern economy, and therefore also the educational system accommodated to the requirements of the powers of society. Specialization in study and technique necessary because of the growing mass of knowledge which can only be managed by the man who knows more and more about less and less, came to be regarded as a virtue in the educational system. A modern educationist recently expressed the view that the school as a social institution is aware of the fact that mankind today needs experts, specialists, one-sided men, because these are the people who promote the progress of civilization and culture.[12]

In what sense is this true? Attracted by the rise of technology, Goethe at the end of his life foresaw the coming age of experts in these prophetic words: "Yes, it is now the time of one-sidedness; lucky the man who understands it, who works in this sense for himself and others. In certain circumstances it is understandable as a matter of course and at once. If you make yourself a skilled violinist, be sure, the conductor will gladly give you a place in the orchestra. Make an instrument of yourself, and expect with confidence that the goodwill of mankind will find you a place in public life." * These lines recommend specialization because every man can

[9] Condorcet. *Nature et object de l'instruction publique.* Prémiere mémoire. In his *Ouevres,* p. 212.

[10] Bernhard, L. *Akademische Selbstverwaltung in Frankreich und Deutschland* (1930).

[11] Arnold, Matthew. *Schools and Universities on the Continent* (1868).

[12] Prihoda, V. *Rationalisierung des Schulwesens* (1935), p. 68.

* From "Wilhelm Meister's Wanderjahre."

only act in public life in a special function, in a certain profession, for which he is skilled. But they express more; the activity of the specialist will only be valuable for mankind if his skill is such as can find a place in the great orchestra of public life. The violinist's, the specialist's, skill involves education towards this co-operation, if he is to make of himself an instrument in a higher body.

The school may therefore differentiate, and give a certain free play to inclinations, but it should take care that every pupil gets acquainted with a wide range of knowledge to make a choice possible. There is hardly a subject which cannit be proposed to pupils without exciting their interest. Only a few pupils have decided inclinations, and often such inclinations lend themselves very readily to change. In general we have failed to capitalize on this catholicity of youthful interest, on the almost unlimited adaptability of the young mind to varied channels of thought. We may pay lip-service to general education, but when our students reach an age where real intellectual potentialities begin to flower we load them down with specialization to such an extent that no time is left for the broader demands of a general education.

Especially is this true in the sciences. The narrowness of the curriculum ordinarily prescribed for science "majors" in American colleges has become the target for many attacks, without any notable improvement. The same is true of the English secondary schools with their specialized "Sixth Forms" and of the intensive specialization of the so-called Honors students in the English universities. Any proposal to broaden the educational pattern for any of these classes of students meets violent opposition among the specialists who do the teaching. It is scarcely in this direction that we are permitted to look for any vitalization of the part that education is to play in the improved social order which some of us hope will follow the present world chaos. Not without reason does Professor Sigerist of Johns Hopkins University say. [13]

> If the German academic world surrendered so readily to reactionary forces, it was largely due to the fact that it consisted of men who were specialists and nothing else. If we wish to educate a citizen able to think in terms of science and a scientist prepared to participate in social action, we must change our teaching. One way—the most promising—is to approach the sciences not only technically but historically, philosophicaly and sociologically.

THE UNIVERSITY AS AN EDUCATIONAL INSTITUTION

Ever since the value of formal education came to be generally recognized, there has been a slow but inexorable upward trend in the average school-leaving age. That wave, the crest of which has for several decades been in the middle 'teens, has not halted there. It is now encroaching onto the university level.[14] Though the gradual advance of this wave has always been attended by problems, social as well as educational, these problems seem to be considerably accentuated by the more recent developments. Now as never before, the educational process is moving its products away from the social and economic levels out of which they came. The result has been to sharpen some of the basic issues of educational policy. Indeed some of these issues are now becoming almost explosive, especially in England and the United States. The opportunity to raise standards of entrance thus presented to the higher educational institutions has been so thoroughly overworked as to exemplify Pestalozzi's characterization of education as "the staircase in the house of injustice."

In all this the universities (in which term American colleges of liberal arts are included) are encountering problems that are perhaps the most far reaching of any that have appeared in their long and useful

[13] Sigerist, Henry E. *Science and Society*, 2, 3 (1938).

[14] Percy, Lord Eustace. *Education at the Crossroads* (1930).

histories. If they accept the new horde of youths ambitious for education they will be forced into profound internal changes. If they do not they will produce such widespread resentment as to jeopardize the popular support hitherto so unstintingly given. It is no wonder that some of the educational axioms always taken for granted are now being sharply questioned and that a considerable degree of confusion is appearing on basic principles of educational policy.

One of the less restrained American pronouncements in this field is the booklet by R. M. Hutchins entitled *The Higher Learning in America*.[15] Hutchins shows the confusion which consists in the fact that the American school cannot make up its mind what purpose it is serving, whether the college is educating for its own aim, or preparing for the university, whether it is general or specialized. Neither have the universities a plan. The service conception and the vocational adjustment prevail, and the educational motivation is neglected. The analysis and criticism of Hutchins are certainly excellent, so far as can be judged from comparison with other American sources, and from a knowledge of the similar situation in Europe. However, it cannot be expected that Hutchins' proposals will be generally accepted, in spite of the fact that he holds a high position in the American educational world. His ideas presuppose a very different interest in college studies from the interest actually shown by students today. This frank abandonment of student interest as motivation in education is quite out of line, I suppose, with most educational trends in the United States.* But the feature of Hutchins' program which seems least likely to win support is his policy of discouraging research as an integral part of the program of higher education. He is right when he states that the universities should be primarily educational institutions; but his dissatisfaction at the way research often hampers the more strictly educational activities is no reason for demanding an absolute separation of teaching and education on the one hand from scientific research on the other hand. Hutchins' conception of an ideal university is derived from Fichte's university plan, and Cardinal Newman's Idea of a University, romantic dreams which can hardly be realized in modern society. The strength of Humboldt's idea of a university was just the connection of teaching and research, and the German universities fulfilled this task whenever possible with great success. Interference from the state, and specialized tendencies of the professors made it at last a failure. However, it would be an interesting undertaking to show that "neohumanistic" educators like Spranger, who stressed the 'Idea of the University,' were really pacemakers of Nazism, which eventually converted the German universities into mere training schools for specialists and called into existence new political 'Schools for Leaders.' Research with its liberal foundations is the necessary counter-irritant against the danger of authoritarian ideas, which always lurks in teaching and education.

There is perhaps an element of danger in other countries than Germany that the wolf of political control may penetrate the educational scheme in the sheep's clothing of humanizing the curriculum. But in view of the times it is a risk that must be taken. The danger will be reduced if educators themselves seize the initiative instead of furnishing a pretext for political pressure by their own inaction on a problem that admittedly calls for prompt solution. There has been an encouraging trend in English universities, though unfortunately men of science are not as prominent in this movement (with a few shining exceptions) as

[15] Hutchins, R. M. *The Higher Learning in America* (1936).

* Salomon, A. *Higher Learning and Humanism*. Social Research, vol. 5 (1938), p. 206, where Hutchins is considered as a moralist, whose efforts are directed toward a spiritual revolution.

they should be.[16] The United States, in its Liberal Arts Colleges, is almost unique in possessing the frame work within which such a development can evolve. The growing project of adult education [17, 18] moreover, could well receive more serious attention than is being given to it by our universities, especially by their men of science.

The ideal of the prosecution of research in connection with teaching at the higher levels was to a great extent projected into the educational scheme by men of science. Though it has now been extended to all subject-matter fields, it is still true that the main support of the ideal centers in the sciences. It is important, however, that in continuing their support of this ideal, men of science shall not put themselves in the position of taking up the cudgels for the entire educational *status quo ante* against all attempts to release it from the narrow specialization that is increasingly being associated with the research ideal. In fact men of science would do well to seize the leadership in educational reform as a necessary condition that the sciences shall have their proper place in the eventual pattern of higher education, not so much for the preservation of the sciences as for the salvation of higher education and perhaps for the very maintenance of our democratic culture pattern.

[16] Löwe, Adolf. *The Universities in Transformation.*

[17] Livingstone, Sir Richard. *The Future in Education* (1941).

[18] Newlon, Jesse H. *Education for Democracy in Our Time* (1939).

THE SIGNIFICANCE OF CERTAIN ESSENTIALS OF ACCURATE THINKING FOR ELEMENTARY SCIENCE *

G. W. HAUPT

State Teachers College, Glassboro, New Jersey

The considerations to be presented are derived from careful study of teachers and children in the classroom. Work of both in-service teachers and those in training is included.

Certain unsatisfactory practices found in elementary school science instruction are described. There is definition of values which are possible from correction of these conditions. Recommendations are made relative to attainment of such values. Some of the unsolved problems in the matter discussed are indicated.

For convenience, and because of prevailing familiarity, the following four divisions are used in analyzing the process of thinking as observed in elementary science instruction: (1) The Problem: Recognition and definition; (2) The Tentative Solution; (3) The Experiment: Test of the tentative solution; and (4) The Scientific Conclusion.

* Presented before the Joint Meeting of the National Association for Research in Science Teaching and the National Council on Elementary Science, Atlantic City, New Jersey, February 22, 1941.

THE PROBLEM

Classroom conditions and practices. Observation reveals that teachers tend to proceed as though a question in a book, or on the blackboard, constitutes a problem. Too few teachers of elementary science realize that a true problem must have emotional implications.

Among children there are pronounced grade and individual differences in ability to recognize problems. One of the principal factors in these grade and indi-

vidual differences in problem recognition is the prior possession by the children of analogous experience.

Recommendations. While teachers and prospective teachers of science are being instructed relative to the facts and principals of science they should also be instructed in the two following methods of utilization of the environment: (1) manipulation of the environment in such a way as to present to learners of the sciences new facts and experiences which will clash with their past experiences; and (2) use of the environment for purposes of bringing to the threshold of a learner's consciousness those experiences which already have been acquired so that they may be related to the new experiences under current consideration.

Implicated problems. There is need for study of grade and individual differences in problem recognition and definition.

Investigation can be profitably directed to that common core of experiences of childhood which is usually acquired before entering kindergarten and which can provide the teacher with bases for precipitation of mental and emotional clashes and dissatisfactions.

A listing and classification, for instructional purposes, is yet to be made of those unusual, striking and anomalous happenings which have great problem possibilities for children.

HYPOTHESIS [1]

Conditions and practices. Many teachers do not realize the instructional values of children's guesses.

A large percentage of beginning teachers, and some of those who are experienced, actually discourage the guess or hypothesis on the part of children.

Some teachers who do realize the importance of children's hypotheses confuse factual accuracy with logical validity. Those teachers do not sense that a child's guess may be logically valid and yet be factually erroneous. Because the guess is factually inaccurate it is quickly eliminated from the instructional process.

Teachers who do recognize the function of hypothesis wrongly believe that the material for children's hypothesis must come from the data under immediate study rather than mostly from background experience. Thus the pitch of the lesson is inappropriate to the learner.

There is a lack of appreciation of the fact that it is the hypothesis which gives pertinence to both the background experience and the data under immediate observation.

Recommendations. Since abstraction is of primary consequence in the derivation of hypothesis, greater attention should be given by teachers to this process.

The demonstration experiment should be used as an aid to direction and control of the process of abstraction.

When the experiment is used to guide abstraction it should vary conditions in three ways: (1) so as to more plainly indicate certain features of the data under consideration, (2) in order to multiply relevant factors in the data, and (3) for purposes of diminishing, concealing or eliminating irrelevant data.

Observation should again be emphasized as of major importance in elementary science instruction. This time, however, the emphasis should be placed upon the relation of observation to hypothesis.

Emphasis upon observation, as it relates to hypothesis, should be directed to two considerations: (1) The operation of observation for accumulation of experience to be used as background for future hypothesis, and (2) Use of observation for verification of hypothesis.

Implicated problems. There is need for study of those kinds of experiences of young children which are most fruitful for them as bases for hypothesis when they

[1] See Haupt, G. W. "A Neglected Factor in the Teaching of Elementary Science." SCIENCE EDUCATION, 23:31–34, January, 1939. Vol. 23, No. 1.

come to deal with later and more highly organized science content.

The mental processes involved in abstraction by young children have been scarcely explored.

A determination of those analogies habitually used by children, and those which might be used by children, will give the teacher of science a powerful educational tool.

Science education will benefit from an examination of hypothesis as a motivating device and as a frame of reference for data for children.

EXPERIMENT

Conditions and practices. Many teachers believe that true experimentation consists of the outward manifestations of trying, testing and experiencing.

A comparatively large number of teachers use the experiment as a device for determination, or demonstration, of unrelated facts.

Comparatively few teachers use the experiment as a trial, test or experience which is controlled by hypothesis.

There is general lack of realization that the purpose of experimentation is test of hypothesis and that the end of experimentation is derivation of conclusion.

The predictive value of experimentation is not utilized and pupils are not apprised of this function.

Recommendations. Criteria for good experimentation in the classroom should be formulated and taught in the teachers colleges. Examples of such criteria are: (1) Is the experiment controlled by an hypothesis which has been as clearly stated as possible?; (2) Does the experiment extend the range of observation? Does it determine new facts?; (3) Does the experiment inform of something besides isolated facts? Is it the basis of comprehensive knowledge?; (4) Is a measure of foresight possible from the experiment?

Instruction in passive experimentation should be given because this kind of experimentation is so common in life. By passive experimentation is meant subjective exploration and comparison of data which are not possible of manipulative control.

Implicated problems. There is need for investigation of the predictive value of experimentation as used with children.

The relation of fact accumulation, by means of experimentation, to prediction of related phenomena constitutes a fertile problem.

Things, or objects, are available for careful analysis from two standpoints: (1) as challenges to children's interpretations, and (2) as evidence to substantiate or invalidate children's beliefs.

CONCLUSION

Conditions and practices. The instructional similarities and differences between a conclusion and an hypothesis are not sufficiently realized.

Teachers and children "jump to conclusions."

Children are permitted to draw particular conclusions when more general ones would be possible and more valuable.

Conclusions are not used in the classroom as premise for attack on new and advanced problems.

Recommendations. Both teachers and children should be given direction in distinguishing the differences between hypothesis and conclusion. Propaganda is a cunning circumvention of conclusive thought. For the layman, scientific conclusions are mainly valuable for the process for which the verbal statements are but a symbol.

Implicated problems. There is need for study of the particular and general conclusions which it is possible for children to draw relative to the various principles of science. When analyses of these conclusions have been made they may then be examined as to their relative possibilities as bases for new investigations by children.

The three instruments of scientific learning are things, words and thought. Things

and words are forms. Thought is vital. We recognized that elementary science can emphasize things too much and concept study was advanced as corrective. We must realize that concept study and object study are genetically and functionally identical and subject to the same high uses and the same degeneration. Continuous research on science as a method of thinking will enable classroom teachers to distinguish product from process. Research on science as a method of thinking will sustain the life which is essential to the form.

AN ANALYSIS OF PRINCIPLES OR GENERALITIES APPEARING IN BIOLOGICAL TEXTBOOKS USED IN THE SECONDARY SCHOOLS OF THE UNITED STATES FROM 1800 TO 1933 *

JOHN IRVIN CRETZINGER

INTRODUCTION

Since an inherent desire to become an instructor of younger teachers was felt throughout nineteen years of teaching General Science and Biology in secondary schools, the writer was motivated by his interest and experience to know the history of the development of the various generalizations as they appeared in textbooks designed for children of early adolescence. This opportunity finally became available when a problem for a dissertation that would apply to both Biology and History of Education was selected.

The element of time was not so important as thoroughness in interpreting scientific writings; therefore, prior to attacking this problem a year was spent in a duly registered course at the University of Pittsburgh in reviewing the whole field of Biology. During that course thirty-three volumes dealing with such subjects as History of Biology, Physiology, Genetics, Evolution, Embryology and others were critically read. Besides these books there were many articles found in encyclopedias and magazines of a legal and religious nature which interpreted certain biological theories in their relation to established religious beliefs. Other important information was obtained by personal interviews with able church leaders of the Protestant, Catholic and Jewish Faiths of both the northern and southern states of the United States to try to determine the attitude of the ministry toward and their interpretation of those biological theories.

THE PROBLEM

The purpose of the study was to trace the appearance and nature of the outstanding biological generalizations through secondary school textbooks from 1800 to 1933. An analysis was made of the changes in conceptions held by the various authors, in chronological order, regarding the various generalizations which affected the content of biological textbooks used in secondary schools in the United States during that period.

No analysis had yet been made to show the development of the generalizations of Biology and of the treatment of those generalizations in biological textbooks written during that period. This study is, therefore, a contribution to the History of Education and to Biological Science.

* Abstract of a dissertation submitted to the Faculty Committee of the University of Pittsburgh in partial fulfillment of the requirements for the degree of Doctor of Philosophy, 1939.

THE METHOD

Fifty-four textbooks covering the period from 1800 to 1933 inclusive were selected to be analyzed in the study. An examination of the content of those books led the writer to believe that all of them had been used as texts, or as collateral reading, in secondary schools some time during that period. It was believed that the selection of books was representative of the biological science that was taught in the secondary schools of the United States during those years. Pamphlets and periodicals were excluded.

The documentary method of research was followed. The books were considered in chronological order and their contents carefully analyzed. Categories were established for classifying the material of all the books. All of the material falling under a given category was classified and organized in chronological order under appropriate topics and sub-topics. The sequential arrangement of the material showed the chronological development of appearance of the generalizations. Succeeding references of identical content were not noted.

The study was designed to show concisely when those various generalizations originated and the approximate time thereafter that they were introduced into texts of that nature; also, what the various authors thought of them as content materials of value to biological science. The study traced the changes in biological concepts:

Theories on the Origin of Life
The Cell Theory
The Germ Theory of Disease
The Concept of Anatomy
The Concept of Health
The Concept of Heredity
The Theory of Evolution
Taxonomy

This is fundamentally a history of what was taught in the field of biological science in the secondary schools of the United States from 1800 to 1933. In a sense it was a history of the Biology Curriculum of schools in the United States, it being generally understood that the curriculum of any field in the past was largely what was found in the textbooks of that time. Since the study was an analysis of the appearance of biological principles and generalizations in those books, it is a history of the development of the use of those principles and generalizations in the books, which in turn constituted the curriculum of that science.

DEVELOPMENT OF BIOLIGY AS A SUBJECT

This study showed that prior to 1900 there were four distinct branches of biological science. Those branches were known as Natural History, Zoology, Botany and Physiology. After the beginning of the twentieth century all of these separate branches were combined into one which was called Biology. That unified study included several new divisions; namely, Embryology, Protozoology, Bacteriology, and several others that have resulted from the more intensified studies of the original fields.

The growth of the study of Biology caused a widespread interest. It prompted secondary school children to become familiar with its principles in their application to health, in the improvement of social conditions and in helping them to develop a scientific attitude in meeting the problems of life. Hence Biology has become one of the most outstanding studies in the curriculum of all recognized secondary school systems.

DEVELOPMENT OF BIOLOGICAL THEORIES AND PRINCIPLES

The development of the teaching of Biological Science in the secondary schools in the United States moved slowly. Early biological textbook writers showed little interest in scientific theories or discoveries that opposed deep-seated established opinions or superstitious beliefs. Such opinions and beliefs caused many scientific theories to be kept out of textbooks for many years until those theories were finally accepted

and included in textbook material of secondary level. The originator of a biological theory seldom lived to see his work fully accepted by writers of contemporary textbooks.

On the other hand, writers seemed willing to present in their books any new discovery of Biological Science that they thought would be generally accepted by the public.

Abiogenesis (spontaneous generation), or the belief that God created life out of the dust of the earth, ran through the texts as an accepted fact until the latter part of the nineteenth century when it began to disappear from the content. The vanishing of this principle was caused by the gradual acceptance, by textbook writers, of the germ theory, which was formulated by Wolff in 1759 [1] and later proved by Pasteur in 1861.[2] Abiogenesis was definitely replaced in the content of the textbooks by the theory of Biogenesis when the work of such men as Wolff and Pasteur was finally accepted by 1910 as valuable information for children of secondary school age.

The theory of Epigenesis (life from life) was formulated by Von Baer in 1850 [3] and was of a nature that made it acceptable to secondary school textbook writers as early as 1851. Metagenesis (alternation of generations) also was given credence by those writers at that early date. It may be presumed that neither of those theories conflicted with any existing belief or practice of that period.

The Cell Theory was talked about since Hooke discovered the "Little Box" in 1665 [4] but was not formulated until the work of Schleiden and Schwann came to light in 1938–39.[5] That work did not get into the secondary school texts, however, until after Mohl discovered the protoplasmic content of the cell in 1846.[6] That new discovery made the Cell Theory acceptable to the textbook writers who soon recognized it as valuable for secondary school science content.

The Laws of Heredity were first formulated by Gregor (Johann) Mendel about 1860, but were kept in the background by textbook writers until about 1900 when DeVries succeeded in demonstrating their value to Biology.[7] The theory of Evolution was finally formulated by Charles Darwin in 1858 [8] but it too was destined to have little acceptance in secondary school books until after 1900 when the convincing evidence of Wallace and Haeckel [9] made that theory acceptable as on the secondary science level.

It was found that many of the principles involved in the program of health in the present secondary school curriculum were merely revisions and re-introductions of ideas that were taught nearly a century ago in the same type of school.

THE RELATION OF SCIENTIFIC METHODS TO SCIENTIFIC FINDINGS

The nature of the content in the later texts in the study showed that there was a positive relationship between the development of scientific methods and scientific findings. After 1900 Biology became one of the major branches of the secondary school curriculum because of its value in the modern program of education.

The later texts showed also that the development of the X-ray, the high powered microscope, and other laboratory equipment have improved the scientific technique of research in the field of finer anatomy. That new development has changed the physiologist's conception of gross anatomy. Those texts showed further that the conclusions of the later scien-

[1] Nordenskiold, E. *History of Biology.* New York: Tudor Company, 1935, p. 249.
[2] Shull, A. F. *Principles in Animal Biology.* New York: McGraw-Hill Book Company, 1924, p. 144.
[3] Mayer, J. R. *Seven Seals of Science.* New York: Appleton-Century, 1937, p. 320.
[4] Shull, A. F. *Op. cit.*, p. 18.
[5] *Ibid.*, p. 19.
[6] *Ibid.*, p. 26.
[7] Nordenskiold, E. *Op. cit.*, p. 588.
[8] *Ibid.*, p. 488.
[9] Nordenskiold, E. *Op. cit.*, p. 514.

tists regarding life processes were based upon actual findings rather than upon the rough calculations resulting from mere observations made by the naked eye. The textbook writers immediately found those techniques and findings to be valuable to the secondary school child, therefore, they were incorporated as content in their books.

The more scientific methods of research brought the general acceptance, by textbook writers, of the Cell and Germ Theories in 1846 and 1910 respectively. The acceptance of those two theories completely revolutionized the fields of Biology and contributed to the importance of that study in the secondary school curriculum as shown by the added interest in the content of their recent books relating to those theories. The discoveries relating to the cell were shown by those writers to come in chronological sequence—first the cell itself, next the protoplasmic content, then the tissue, and lastly the organ.

Another fact revealed by those authors in their books was that closer observation of Metagenesis resulted in simplifying the classification of lower animals, while the further study of Epigenesis rightly furnished the basis for Darwin's theory of evolution.

The writers also showed how the later methods of experimentation revealed that the influences of environment had replaced many of the older ideas regarding predisposed diseases. The texts also showed that the principles of heredity had been applied to lower animals and plants to a greater extent than to the improvement of man; thus keeping too largely Euthenics and Eugenics as unappreciated branches of biological sciences.

RELIGION AND THE THEORY OF EVOLUTION

Many able church leaders had accepted evolution as a process of gradual change in life with improvements. They believe it did not oppose true religion, but went hand in hand with it, and that it had already challenged certain religious doctrines. Other Christian leaders considered it an open question that should not be discussed by any person except a well-informed biologist. Some of the churches had taken the stand that the religionist's opinion on that question should be his own and not that of his church.

The objection to the teaching of the theory of evolution in the public schools seemed to be based upon the conflicting ideas of the Vitalists, those who believed that life in all of its forms was planned and created by God, and the Mechanists, who believed that movements (tropisms) in animal life are caused either by outside influences or by chemical content of the cells in the animal.[10] That opposition seemed to have its effect upon textbook writing for various states, particularly in the South. There was no law to prevent the theory of evolution from being taught in any state until 1925, when Tennessee took the first legal stand against it. Until that time, those who boldly opposed it did so entirely from the standpoint of their religious beliefs.

[10] Nordenskiold, E. *Op. cit.*, p. 605.

SOME SIGNIFICANT CONCEPTS AND BELIEFS IN ANTHROPOLOGY AND BIOLOGY OF ENTERING COLLEGE FRESHMEN AND THE RELATION OF THESE TO GENERAL SCHOLASTIC APTITUDE

LYNN L. RALYA AND LILLIAN L. RALYA
The Citadel, Charleston, S. C.

This report presents the results pertaining to anthropology and biology of an investigation motivated by the hypotheses: (1) that there are many scientific concepts, principles, and beliefs which are so relatively simple and so significant for lay thinking that they could and should become a part of the mental equipment of most people and (2) that investigations of the extent to which specific strengths and weaknesses exist in such knowledge should provide data which will eventually lead to improvement in science teaching at all educational levels comparable to the improvement in language teaching brought about by study of the relative frequency of errors in English usage or in arithmetic teaching by the determination of the relative difficulty of the various arithmetical processes. Attempt was made in this investigation to determine, for a group of entering college Freshmen, (1) the degree of mastery of some specific elementary and basic science concepts; (2) the degree of prevalence of some misconceptions and unfounded beliefs hindering such mastery; and (3) the relationship between the acceptance of the correct and the rejection of the false concepts and beliefs and general intelligence—or scholastic aptitude, at it is more appropriately called.

SOURCES OF DATA

The subjects cooperating in the investigation were the entering Freshmen at a state college for men located in the Southeast and enrolling about 1,000 students. According to comparative results on the American Council Psychological Examination, these students may be considered fairly representative in general scholastic aptitude of Freshmen entering colleges and universities in the region. The assumption that the subjects are also representative in formal and informal educational background in science would probably be a reasonable one, although this study is centered on the subjects' performance and ability and is not particularly concerned with their previous education.

The tests used were (1) a "Science Inventory" constructed especially for the investigation and consisting of 232 true-false items and (2) the American Council Psychological Examination, previously referred to. The 82 items of the Science Inventory pertinent to anthropology and biology are considered here.

In the construction of the Science Inventory attempt was made to select such important concepts and principles as could conceivably be almost universally mastered and such significant misconceptions and unfounded beliefs as were known or suspected to exist extensively. The sources from which selection was made included: (1) state courses of study in elementary science; (2) the book, *The Story of Human Error*, edited by Jastrow;[1] a study of misconceptions in science held by a group of prospective elementary teachers;[2] and (4) studies of the prevalence of unfounded beliefs and superstitions by a number of investigators.

[1] Jastrow, Joseph, Editor. *The Story of Human Error.* New York: D. Appleton-Century Co., 1936.

[2] Ralya, Lynn L., and Ralya, Lillian L. "Some Misconceptions in Science Held by Prospective Elementary Teachers." SCIENCE EDUCATION, 22:244–251, October, 1938.

The Science Inventory and the American Council Psychological Examination were both administered as part of the regular testing program of Freshmen Week. Nearly all subjects finished the Science Inventory in the time allotted. The papers of the 325 Freshmen who answered all items on this test provided the data for this report.

TREATMENT OF DATA

For each of the items of the Science Inventory the per cent of incorrect responses was computed (1) for all 325 subjects, (2) for the 100 subjects scoring highest in scholastic aptitude, and (3) for the 100 subjects scoring lowest in scholastic aptitude. The correlation between the positive scores on the Science Inventory and the positive scores on the American Council Psychological Examination was also computed and found to be +.59. The 82 items of the Science Inventory pertaining to anthropology and biology (mostly biology) and the results obtained on them are presented in the table which follows.

RESULTS ON SCIENCE INVENTORY ITEMS CONCERNING ANTHROPOLOGY AND BIOLOGY

No.	Item	Per Cent of Subjects in Error		
		Schol. Apt. Groups		
		All 325	Upper 100	Lower 100
1.	The earth is located at the center of the universe	15	5	23
2.	The heavenly bodies exist to give light to man	42	26	56
3.	Every plant and animal in the world is of some use to man	68	75	70
4.	Man is guided entirely by reason, while animals are guided entirely by instincts	52	30	74
5.	The earth is millions of years old	10	5	13
6.	Man has been on earth for at least fifty thousand years	30	18	39
7.	Each species of plant and animal now in existence existed at the beginning of life on earth	23	6	38
8.	Ten thousand years ago all people were of the same race	31	25	35
9.	Man's state in the remote past was far preferable to his state in the present	13	3	26
10.	Fossils are remains of animals drowned during the Flood	22	15	28
11.	Negroes are dark because the sun came close to Africa at some time in the remote past	10	8	6
12.	Training an animal to do tricks increases the ability of the animal's young to do these same tricks	34	29	37
13.	Children of long German ancestry have greater inborn ability to learn German than children of long English ancestry	42	33	48
14.	Each generation advances in native (inborn) intelligence over the preceding generation	48	36	53
15.	Any seed which will grow contains material which is alive	12	12	13
16.	Yeast cells are sometimes created by the fermentation of sweet substances	80	77	76
17.	Eels are sometimes generated from mud	9	7	14
18.	Insects are sometimes created by the decay of matter	27	19	43
19.	Animals which are born alive generally develop from eggs	59	51	63
20.	Unfertilized hen's eggs will *not* hatch	23	20	26
21.	All human beings begin their individual lives as fertilized eggs	30	16	37
22.	The human egg (female) cell furnishes only nourishing material for the growth of the sperm	51	38	62
23.	A child is more closely akin to the mother than to the father	49	40	58
24.	A human sperm (male) cell contains a minute human being	26	18	42
25.	A child is more closely akin to the father than to the mother	7	7	10
26.	The blood of the mother flows in the veins of the unborn child	73	68	74

No.	Item	Per Cent of Subjects in Error		
		Schol. Apt. Groups		
		All	Upper	Lower
		325	100	100
27.	Man is instinctively war-like	59	52	65
28.	Man is instinctively pacifistic	43	30	50
29.	On the average men and women are born with equal intelligence	26	26	28
30.	The white race is known to be superior by nature to all other races in average intelligence	73	57	85
31.	Alcoholism is inherited	9	7	15
32.	The offsprings of married cousins are always inferior	24	15	29
33.	Most cases of insanity have been proven to be hereditary	72	71	76
34.	Hereditary aristocracy is more biologically natural than democracy because of the wide differences in abilities among men	56	50	63
35.	The only practical way to improve society is to improve the human stock through the application of eugenics	58	50	58
36.	The starches and sugars are good sources of heat and energy for the body	20	10	30
37.	The fats of foods are good sources of heat and energy for the body	8	7	7
37.	Protein foods are needed to build and repair the body	1	0	2
39.	The white portion of milk is protein in character	39	29	51
40.	The white portion of milk and the lean portion of meat serve about the same purposes in the diet	36	31	36
41.	Digestion of food begins in the mouth	21	9	25
42.	Fish are an especially good food for the brain	39	31	49
43.	Raw meat makes dogs fierce	27	16	40
44.	Raw meat makes men stronger than meat thoroughly cooked	33	18	49
45.	The common housefly spreads disease	4	2	5
46.	Typhoid fever is due to germs	7	2	10
47.	Most kinds of bacteria are harmless	27	19	34
48.	Pasteurized milk contains some living germs	38	37	38
49.	Mosquitoes inject malaria and yellow fever germs into people in order to weaken and eliminate their enemies	10	9	12
50.	Night air is the cause of several diseases	21	12	32
51.	Teeth that are carefully kept clean never decay	30	21	38
52.	For every disease of man there is a specific plant or animal food which will effect a cure	25	13	33
53.	Strong coffee is a good remedy for malaria	14	9	20
54.	Quinine is falsely believed to be a remedy for malaria	18	13	20
55.	Snake oil makes muscles supple	21	14	26
56.	Strong men always have more hair than weak men	5	4	9
57.	People with large muscles are healthier than people with small muscles	21	11	30
58.	If a mushroom blackens a silver spoon it is poisonous	42	33	44
59.	Primitive people are more susceptible to certain diseases than we are	53	49	49
60.	It is desirable that some movement take place during sleep	12	6	13
61.	The more intelligent children are healthier than the less intelligent, on the average	66	72	65
62.	The green coloring material (chlorophyll) in plants is essential to their growth	15	12	15
63.	Light is as essential as heat to the growth of plants	7	8	4
64.	All of the material entering into the formation of a tree comes from the soil and water	43	36	54
65.	Some compounds made by plants and animals can be manufactured by man	13	10	15
66.	All buds on a plant are capable of developing into flowers	46	37	44
67.	The function of a flower is to produce seeds	33	27	34
68.	The tadpole develops into a frog	4	2	5
69.	Fish breathe air which is dissolved in water	19	25	22

No.	Item	Per Cent of Subjects in Error		
		Schol. Apt. Groups		
		All	Upper	Lower
		325	100	100
70.	Bacteria are plants	24	26	34
71.	The whale is a large fish	14	2	21
72.	The ostrich is a bird	18	16	23
73.	The bat is a bird	20	12	29
74.	All people may be classified into one or another of the common racial groups	71	58	78
75.	The queen bee is *not* the ruler of the hive	81	73	85
76.	The cat sees much better at night than do most animals in the daytime	56	37	71
77.	The ostrich is capable of digesting any non-poisonous substance	39	33	49
78.	The goat normally digests metal objects	17	12	26
79.	Porcupines protect themselves by throwing their quills	49	31	64
80.	The toad produces warts when handled	13	5	21
81.	Bees carry pollen in order to repay the plants for the nectar which they receive	26	17	34
82.	The severity of a coming winter can be predicted in the fall by the thickness of the furs of wild animals	54	45	58

INTERPRETATION OF RESULTS

A study of the items of the table will show that nearly all of them, both the true and the false, are stated positively—a fact which tends to reduce the errors made through mere mental confusion. Moreover, most of the items are concerned with materials so often encountered or so simple in character that some degree of understanding, belief, or bias will be present in the minds of most of the subjects and tend to reduce "pure guessing" to a minimum. Nevertheless, a significant number of subjects may have engaged in "pure guessing" on some of the items; nor should the possibilities of unintended interpretations of items by a significant number of subjects be overlooked as interpretations of the results are ventured.

The once almost universal belief that the earth is located at the center of the universe, a belief vigorously defended as essential to a wholesome conception of the nature and significance of man, has apparently almost disappeared in the group of highest scholastic aptitude, although about one fourth of the group of lowest scholastic aptitude would seem to retain it, according to the results obtained on item 1 (1)[3] However, the homocentric view of mans' nature, a view currently held by many to be essential to a wholesome conception of man, would seem to be widely held in even the group of highest scholastic aptitude, since the statement that the heavenly bodies exist to give light to man is accepted by 26 per cent and the statement that every plant and animal in the world is of some use to man is accepted by 75 per cent of this group (2, 3). It is also worthy of note in this connection that a statement of the traditional belief that man is guided entirely by reason while animals are guided entirely by instincts is subscribed to by about 50 per cent of the entire group of subjects and by 30 per cent of the group of highest scholastic aptitude (4).

Belief in the outmoded conception of "spontaneous generation," a conception once used by scientists as a weapon to fight the dogma of "special creation," is widespread in this group according to the results obtained on four items (15–18). A scientific belief of one period often becomes an

[3] Numbers in parentheses refer to item numbers in the table.

unfounded popular belief of a later period. It is impossible to determine just how many in total entertain this belief in some form or other, however, since some subscribe to it with reference to one kind of organism and some with reference to another.

The topic of heredity is represented by items 19–35 and 12–14. It appears that, of the entire group of subjects, 30 per cent do not know that all human beings begin their lives as fertilized eggs, 51 per cent think of the egg as furnishing only nourishing material, and 73 per cent believe that the blood of the mother flows in the veins of the unborn child (21, 22, 26). With such extensive lack of understanding of some of the rudiments of hereditary mechanics it is not surprising that 49 per cent subscribe to the statement that the child is more closely akin to the mother than to the father (23).

Nor is it strange that many should subscribe to a belief in the inheritance of acquired characteristics, a conception once used by the Lamarkians as an explanation of the mechanics of organic evolution. Each of three statements embodying this belief is subscribed to by about one-third of the group of highest scholastic aptitude and by a somewhat larger fraction of the group of lowest scholastic aptitude (12, 13, 14).

Understanding of and desirable attitude toward some of our most important social and political problems would seem to require, for one thing, a greater degree of comprehension of the elementary facts and principles of heredity than many of these subjects have displayed. It is consequently not surprising that 72 per cent of the subjects apparently believe insanity to be largely hereditary, that 56 per cent of these future citizens of what we hope will remain a democracy would seem to believe that hereditary aristocracy is more biologically natural than democracy, and that 58 per cent subscribe to the statement that the only practical way to improve society is to improve the human stock through the application of eugenics (33, 34, 35). Attention should also be called to the fact that these fallacious beliefs are almost as prevalent in the group of highest scholastic aptitude as in the group of lowest. In addition, it should be pointed out that 73 per cent of the entire group subscribe to the statement that the white race is known to be superior by nature to all other races in average intelligence, while the acceptance reaches 85 per cent in the group of lowest scholastic aptitude (30).

The results already considered concerning the topics of spontaneous generation and inheritance of acquired characteristics bear on an evaluation of these subjects' conception of organic evolution. Items 5–11 are also concerned with evolution, and the results are revealing. All but 10 per cent of the entire group allow the earth an age of millions of years; however, 30 per cent of them refuse man even a modest age of 50,000 years (5, 6). While only 6 per cent of the group of highest scholastic aptitude accept the statement that each species of plant and animal now in existence existed at the beginning of life on earth, 38 per cent of the group of lowest scholastic aptitude accept it (7). Only 3 per cent of the group of highest scholastic aptitude accept a statement of the "golden age" belief, but 26 per cent of the lowest group accept this statement (9). It is interesting that 22 per cent of all subjects and 15 per cent of the group of highest scholastic aptitude subscribe to the statement that fossils are the remains of animals drowned during the Flood (10).

Items 36–44 concern food. From 80 to 99 per cent subscribe to correct statements of the functions of fats, carbohydrates, and proteins in the diet (36, 37, 38). However, it would seem that "verbal knowledge" of the nutrient protein is much greater in amount than the "functional knowledge," for, while 99 per cent accept a correct state-

ment of the purpose served by protein in the diet, only 61 per cent accept the statement that the white portion of milk is protein in character, and only 64 per cent accept the statement that the white portion of milk and the lean portion of meat serve about the same purpose in the diet (38, 39, 40). Statements of the "raw meat" fallacy and a statement of the "fish as brain food" fallacy are each subscribed to by about one third of the subjects (42, 43, 44). It should also be pointed out that the acceptance of these fallacies is much greater in the group of lowest than in the group of highest scholastic aptitude.

Items 45–61 are devoted to health. It is gratifying to note that nearly all of these subjects know that the common housefly spreads disease and that typhoid fever is due to germs (45, 46). However, the results on the items concerning the regional problem of malaria are not very satisfactory, since quinine is rejected as a remedy by 18 per cent and strong coffee is accepted as a remedy by 14 per cent of these subjects (54, 53). In addition 21 per cent accept the statement that night air is the cause of several diseases and would, presumably, include malaria among such diseases (50). Acceptance of these fallacious statements concerning malaria is much greater in the group of lowest scholastic aptitude than in the group of highest.

Of the additional items devoted to health, attention is called especially to a few. That teeth which are kept clean never decay is believed, apparently, by 30 per cent of the subjects; that for every disease of man there is a specific plant or animal food which will effect a cure, by 25 per cent of the subjects (51, 52). It should also be pointed out that 66 per cent reject the statement that the more intelligent children are healthier than the less intelligent and that the rejection is greater in the group of highest than the group or lowest scholastic aptitude (61).

Items 62–69 constitute a group dealing with biological facts not considered elsewhere. It should be noted that, while a very large percentage of these subjects apparently know that both light and chlorophyll are essential to plant growth, 43 per cent are unaware of the fact that the carbon-dioxide of the atmosphere is, since that number subscribe to the statement that all of the material entering into the formation of a tree comes from the soil and water (62, 63, 64).

Although comprehensive knowledge of the systematic classification of plants and animals is no longer considered essential to a general education, it is thought that the absence of common misconceptions concerning classification might well be. Items 70–74 represent such common misconceptions. Particularly should it be pointed out that 71 per cent accept a statement of a belief most useful to some dictators—the statement that all people may be classified into one or another of the common racial groups (74).

What is sometimes referred to as "unnatural natural history" is represented by items 75–82. While such beliefs are much more prevalent in the group of lowest scholastic aptitude than in the group of highest, the prevalence of some of them is very high in even the latter group. The statement that the queen bee is *not* the ruler of the hive is rejected by 73 per cent and the statement that porcupines protect themselves by throwing their quills is accepted by 31 per cent of this superior group (75, 79).

SUMMARY AND CONCLUSIONS

This study has dealt with the reactions of 325 entering college Freshmen to each of 82 items representing true and false concepts and beliefs in anthropology and biology. For each of the 82 items the responses (1) of the total group of 325 subjects, (2) of the group of the 100 subjects ranking highest in scholastic aptitude, and (3) of the group of the 100 subjects ranking lowest in scholastic aptitude have been

presented. Interpretations of some of the results have been ventured. Since the study is concerned primarily with specific concepts and beliefs rather than with general accomplishment in anthropology and biology, but few generalizations can be made. It may, however, be said that (1) the relative prevalence of certain concepts and beliefs has been determined for a group of subjects with some degree of objectivity, (2) that the degree of prevalence of specific concepts and beliefs offered no reliable index to the degree of prevalence of closely related ones, and (3) that, while the success of the group of highest scholastic aptitude on specific concepts and beliefs was generally greater and sometimes much greater than that of the group of lowest scholastic aptitude, this relationship would furnish no very reliable means of predicting the prevalence of any one specific concept or belief among members of groups of relatively high or relatively low scholastic aptitude, since the relationship varied so much from item to item.

In the light of the results of this investigation it is concluded that studies of the prevalence of specific concepts and beliefs in the science subjects might well be increased in number to provide data upon which the improvement of science instruction could be based. Perhaps much of the effort now devoted to investigation of the general level of accomplishment in these subjects would be more productive if it were diverted in this relatively new and relatively unexplored direction, since a considerable body of rather stabilized knowledge concerning the general level of achievement has already been built up.

THE KNOWLEDGE OF PHYSICAL AND CHEMICAL SCIENCES NEEDED FOR PERSONAL USE *

GEORGE WARREN DAVIS

Roosevelt High School, Los Angeles, California

Improvement of the teaching of any subject is fundamentally determined by the needs of the pupils to be instructed and not upon the facts or principals that make up the subject matter. The science courses we offer to the students of our present day high schools should be of permanent value, not only to the students who will enter institutions of higher learning, but also to those who do not expect to receive instruction beyond the secondary level.

When, in this highly scientific age, the enrollment in the physical and chemical sciences of our high schools continues to decline, we, the science instructors, should realize that the time has come for a revision of the courses we generally offer in physical and chemical sciences—a revision which will provide the students who will terminate their formal schooling at the secondary level with courses that will give them useful and practical knowledges and skills. However, if we are true science instructors, we shall seek to determine to a very accurate degree the needs of the pupils we are to instruct and to construct the content of our new courses upon the indicated needs, before such revisions are undertaken.

Six specific conditions have developed in the educational and social life of America today that make the study of personal needs of the individual necessary before any attempt is made to set up a course of study.

* This study was completed several years ago but the philosophy and suggested technique contained in it are pertinent today as they were then.

They are: (1) emphasis has shifted from subject matter to pupil; (2) increasingly large numbers of pupils have enrolled in high schools; (3) the increased enrollment has resulted in a wide variation in the general nature and characteristics of the pupil personnel; (4) the aims of high school instruction have changed from that of preparation for college to that of preparation for citizenship; (5) to fit the subject matter to the pupil, we must consider his social heritage and his economic and cultural background; and (6) pupils must be thought of as consumers of science rather than as producers of science.

Before attempting to teach any science subject, the instructor should examine the major aims of all science instruction to see if they are in conflict with the present day social viewpoint of education—emphasis upon present day needs. He must know toward what major goals he is directing his pupils and what immediate objectives his pupils must achieve day by day in order to reach these goals.

The major goals of science instruction are: (1) the acquisition of those skills which are based upon the most important scientific knowledge—important because it enables the pupil to solve his problems of health, of home, of vocation—and which involve science; (2) the development in the pupil of skill in scientific thinking, including a knowledge of the elements in the process, an awareness of the safeguards that must be observed to prevent erroneous conclusions, and much practice in the art of scientific thinking; (3) the establishment in the pupil of those major emotionalized standards and attitudes that serve as motives of his many daily acts that involve science.

These aims of scientific instruction actually supplement and emphasize the social aims of instruction as stated by the National Educational Association, namely, health, fundamental processes, worthy home membership, good citizenship, wise choice of and efficiency in a vocation, the wise use of leisure, and moral integrity.

With this fundamental educational philosophy in mind, the writer made this study to determine:

1. With what mechanical appliances, the operation and maintenance of which requires some knowledge of chemistry or physics, do the majority of secondary school students come in daily contact?
2. What is the combined science need of the high school group in this respect?
3. Does this need vary by grades? If so, why? And in what ways?
4. Does the racial background of the home have any bearing upon the need of the individual student?
5. What do the findings of this investigation indicate as to the following problems:
   a. Can present science courses be revised to meet this need and still serve as a basis for college entrance?
   b. Will it be necessary, rather, to provide parallel science courses—one for students seeking college entrance and one for those who do not expect to go to college?

The information for the study was secured from a questionnaire of one hundred seventy questions submitted to 2,800 students of Roosevelt High School, Los Angeles, California. The students were from the homes of the following nationality groups: Jewish, Mexican (Spanish), Japanese, English, (Scotch, Irish, Canadian), Russian, German, Italian, Slavic, Armenian, French, Negro, Swedish, Austrian, Polish, Dutch, Syrian, Greek, Welsh, Danish, Chinese, Norwegian, Finnish, Turkish, Romanian, Lettish, Lithuanian, Arabian, Philippino, Scandinavian, Portuguese, American.

To avoid duplications and eliminate inaccurate questionnaires, the final report was based on the physical and chemical equipment contained and used in the homes of 2,134 pupils. To determine the needs in the field of physical and chemical sciences of the pupils and their homes the writer considered the numbers and percentages reporting use and the number reporting non-use of the following items: electrical

equipment; sanitary equipment including heating equipment and systems of ventilation; automobiles; musical instruments; certain household, garden, and commercial tools; services of various kinds; and simple chemicals. Data were compiled by grades of the percentage reporting use of: kitchen equipment, musical instruments, bathroom equipment and supplies, garden and workshop tools, automobiles, various miscellaneous equipment, home remedies used in case of accidents or illness, and miscellaneous services. Data were also collected by grade and race of the extent of the use of: kitchen equipment, bathroom equipment, and musical instruments.

One important fact disclosed by this investigation was that electricity was almost universally used in the homes of the students of Roosevelt High School. More than ninety-six per cent of the homes represented were equipped with electric lights and radios. A surprisingly large number of homes were equipped with clothes washers, mangles, vacuum cleaners, and sewing machines. More than forty-four per cent reported the presence of electric refrigerators. Even sun lamps and electric ranges were by no means unknown.

In the matter of modern plumbing and other sanitary equipment, the tabulations from the study indicated that most of the homes were adequately supplied with those essentials of modern living. Of the total number included in the investigation, practically ninety-four per cent had bathrooms with hot and cold water; indeed, quite a number of these homes reported the possession of more than one bathroom.

More than ninety per cent of the families cooked their food and heated their homes by the use of gas. In a few, wood burning ranges and heaters were reported. Household tools in a wide variety were extensively reported by all of the homes studied. Practically sixty per cent owned automobiles, and over twelve per cent owned more than one.

The students to whom the questionnaire was submitted reported a rather general incidence of musical instruments in their homes, the most popular types being the upright piano, harmonica, violin, and phonograph. A few reported use of cornets, horns and various other musical instruments.

Garden tools were extensively used. Such articles as thermometers, barometers, binoculars, adding machines, and typewriters were reported in many homes. Bicycles showed an incidence of about thirty per cent, and an occasional motorcycle was reported.

In the majority of homes, such activities as baking, washing of clothes, house cleaning, sewing, canning of fruits and vegetables, and the cleaning and repair of garments were carried on.

There was little variation in the incidence of occurrence of electrical equipment, musical instruments, bathroom equipment and supplies, typewriters, tools and workshop equipment, automobiles, or other types of physical or chemical equipment used and daily contacted by the students, by either grade or racial groups.

The principle facts discovered by this study which had a bearing upon the question of offering parallel courses in science in the high school were:

1. All students in the high school, irrespective of grade and of racial background, were brought into daily contact with a large number of electrical devices, with modern sanitary plumbing, with a variety of garden and household tools, with automobiles, and with a number of musical instruments. Hence, all high school students had an obvious need of knowledge in the fields of science in which such tools and equipment operate.

2. Many of these students left school at the end of the tenth grade, and many more at the end of the eleventh.

3. A small number finished the twelfth grade, and of this group, a few attended colleges and universities.

4. Obviously, the needs of the few who went on to institutions of higher learning were much more technical than those of students who did not finish high school. Therefore, no one science course can be devised which will meet the need of all high school students. On the contrary, parallel courses must be offered. Such courses should include, for boys, practical arts in electricity, shop work, and auto mechanics; for girls, courses in the household arts, sanitation, and the chemistry of foods. These practical arts courses should, presumably, be offered in grades ten and eleven. In the twelfth grade, both boys and girls may be offered college preparatory courses in physics and chemistry.

At the conclusion of this study, the investigator was convinced that much further study was needed in this field. Many students were registering for technical courses in science who were unsuited both in temperament and mental fitness to cope with their problems; and on the other hand, many who registered for work in the practical arts were merely bored by the work because their minds were of the technical and research type. The difficulty in this situation was that at the time of such registration, neither, the student himself nor his instructor could tell for which type of work he was suited. Only by the trial and error method—so wasteful of time, energy, and equipment—could the student's real science need be determined.

It is recommended, therefore, that in the early years of high school period an experimental demonstration course in the physical and chemical sciences be offered. Such a course should be given to large groups—as many as one hundred pupils in a class; it should be given in a large room, fully furnished with modern laboratory equipment, and should be presented by the lecture-demonstration method. It should serve to acquaint pupils with the underlying principles of those manifestations of physical and chemical sciences with which they are in daily contact—for instance, foods and medicines, electricity, fire, water, gases, textiles, home equipment, and transportation.

It is further recommended that from such lecture-demonstration class a series of tests be developed to be given to students at the conclusion of this course. This would make it possible to identify definitely the students whose interests and aptitudes are purely in the motor fields and who should enroll for work in the practical arts field. At the same time these tests should indicate the students whose interests and aptitudes are of the technical and research type, and who should be encouraged to enroll in science courses of college preparatory content.

The investigator is of the opinion that research and experimental work in these fields are urgently needed.

YOUNG SCIENTISTS CLUB MAKES A BOOK

ELEANOR L. O. HEISLER
Midland School No. 1, Rochelle Park, New Jersey

Ever since the forming of the "Young Scientists Club" earlier in the term and through the editing of the "Constitution" for the Club, the children of 5B were growing more and more enthusiastic about doing things in the name of the Club.

One morning one of the boys said, "Look what we found in the swamp, Miss Heisler."

The children crowded around. "What is it?" "Do you think it will grow?" "How odd, three swellings on a root."

It was suggested that the boys immerse half of each of the three bulbs in water using a glass bowl so that the bulbs might be observed each day.

"Why not cover it with water?"
"Are they seeds?"
"If it grows, what will come out first?"
"Will it have leaves?"
"What kind of flower will it have?"

These questions and many more were asked about the embryo plant. On the desk were many books on Science and the children referred to them. When one was found with a unit on "Plants," the children settled in their seats for the story of how plants grow. There were experiments in the book which we tried. Beans were brought in, placed between wet blotters, in jars of water, and in soil. When the roots came on the beans under the blotters, they were measured with a ruler and marked off in quarter inches with ink, while the beans in the jars and soil were left to grow undisturbed. It was noted that the root grew first and that the very end of the root continued to grow, and had roothairs.

As the children watched the growth in the jars with the tiny roots pushing their way between the pebbles in the glass, one kind-hearted little girl was put at ease when told that there were rootcaps to protect the roots.

During English period, the class wrote this story about roots and included it in their book in this form:

ROOTS

WHEN WE PLANT A SEED THE ROOT GROWS FIRST. THE ROOT ABSORBS THE WATER SUPPLY FOR THE PLANT. WHEN THE ROOTS CAN NOT ABSORB WATER THE PLANT DIES. ROOTS GROW DOWNWARD. LITTLE ROOT HAIRS GROW NEAR THE GROWING POINT OF THE ROOT. THE ROOT HAIRS LIVE A FEW DAYS THEN THEY DIE AND NEW ONES GROW NEARER THE GROWING POINT. THE GROWING POINT IS PROTECTED BY THE ROOT CAP.

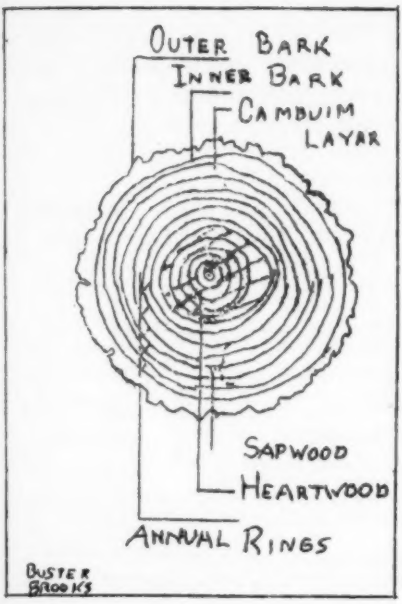
"Does everybody know about the roots roothairs and rootcaps?"

"Let's print another book like our 'Constitution' and call it the 'Garden Book'!"

That afternoon Billy brought his junior typewriter, and the book which was a thought in the morning was the activity for the rest of the term. The children had to examine the machine, push the keys, and slide the carrier back and forth. It was worked with a string and many times during the proof-typing and stenciling, the string would become indisposed and refuse to move the carriage. We tinkered around at first and later became very adept in restoring movement to the carriage every time Billy or Dorothy would call, "Miss Heisler, it's stopped again!"

The children brought onions and seeds of all kinds and experimented with them. We were allotted a space on our school ground and each child had a garden a yard square with an experimental garden a yard square in which there were two rows of carrots and two rows of radishes. Every three days after the plants appeared above the ground a radish and a carrot were pulled up and observed. This continued until the radishes reached maturity.

We took several observation walks and on one of them found an old stump of a tree that showed annual rings. Immediately questions were raised.



18

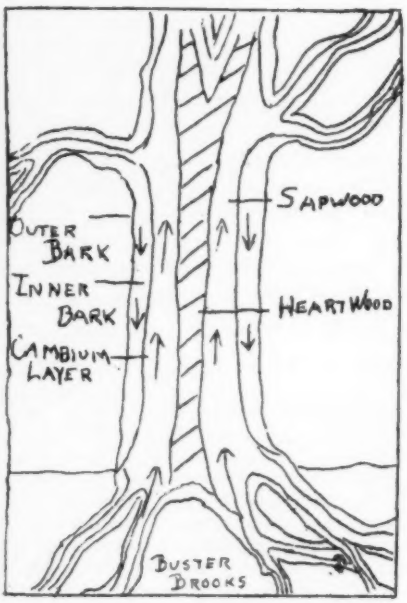
TREES

THE PICTURE SHOWS A CROSS SECTION OF STEM OR TRUNK OF TREE.

THE ANNUAL RINGS TELLS US HOW OLD THE TREE IS. EACH RING IS YEAR'S GROWTH. IF THERE ARE TEN RINGS THE TREE IS TEN YEARS OLD. HOW OLD IS THIS TREE?

TREES GROW FROM THE TIPS OF THE BRANCHES AND THE TIPS OF THE ROOTS. DURING THE YEAR THE TREE GROWS A LITTLE ALL OVER. THE TRUNK GETS LARGER. THE ROOTS GROW DEEPER AND WIDER. THE BRANCHES GROW HIGHER AND LONGER.

19



20

TREES

THIS PICTURE OF THE TREE SHOWS THE TREE CUT IN HALF LENGTHWISE. WE SEE THE HEARTWOOD, INNER BARK AND OUTER BARK, SAPWOOD CAMBIUM LAYER.

THE HEARTWOOD IS THE DARKER CENTRAL PART. IT IS NO LONGER LIVING IT ACTS AS THE BONE OF THE TREE.

THE SAPWOOD IS ALIVE. WATER PASSES THROUGH THE SAPWOOD FROM ROOTS TO LEAVES.

THE CAMBIUM LAYER IS THE GROWING LAYER OF TREE. EACH YEAR THE CAMBIUM LAYER ADDS TO THE INNER BARK AND SAPWOOD FORMING A NEW LAYER RING.

THE FOOD PASSES FROM THE LEAVES DOWNWARD IN THE INNER BARK

THE OUTER BARK IS USED FOR PROTECTION OF THE TREE. IT IS DEAD.

21

"How were they formed?"
"Do all trees look like that when they are cut in half?"
"How do trees grow?"

Back to the book again for more information. Outside for more observing, finding more stumps of trees with annual rings. The children had lots of fun counting them and thinking back over the years and speculating about how the place looked when the tree was young. In Arithmetic we figured the approximate dates when the trees started to grow. In English the class again wrote stories. The following stories were printed in our book. All pictures were drawn in Art both from life and from books.

Each topic in the book was taken from the children's observations and questions asked. As the book was taking form, the children studied library books, readers, geographies, story books, histories and found that most books had a name, author, publisher, a preface, a table of contents, and pictures illustrating the story. They also found that the contents of the books were in logical order.

The name of the book was changed from "Garden Book" to "Plant Life," which with the authors, The Young Scientists Club, Publisher—Midland School No. 1, Rochelle Park, N. J. were on the first page. The second page was given over to the names of the Art Editors and Typists. The third page contained the Preface and the fourth the Contents which were made as follows after much discussion in Club period.*

CONTENTS

PREFACE - 3
A PLANT-PICTURE - 5
ABOUT PLANTS - 6
SEEDS-PICTURE - 7
SEEDS-STORY - 8,9,10,11
ROOTS-PICTUREAND STORY - 12
STEMS -PICTURE AND STORY- 13
LEAVES- PICTURE - 14
LEAVES- STORY - 15
FLOWERS-PICTURE - 16
FLOWERS- STORY - 17
CROSS- SECTION OF TREE PICTURE - 18
TREES- STORY - 19
LENGTHWISE SECTION OF TREE-PICTURE - 20,21
INTERESTING FACTS ABOUT PLANTS - 22

The following examination was given to the children. The lowest mark was 90.

1. Seeds are scattered by ....., ... and .....
2. When a seed is planted the ..... grows first. Little .... grow near the .... which is protected by the ....
3. ..... grow downward and ..... grow upward.
4. Water passes through the ..... from the ..... to the .....
5. Leaves .... through the process of photosynthesis with ..... in ..... While photosynthesis is going on, leaves breathe out .....
6. Without ..... we would have no seeds.
7. Some plants protect themselves with ..... or .....
8. The needles of a pine tree and the spines on the cactus are .....

The entire book was first typed and put together just as it was to appear when finished. The stencils were then made according to the proof. Miss Scott, Principal of Midland School and I mimeographed them. On the last day of school all sheets were ready to be made into books. The children stayed after June dismissal getting the pages together and stapled, and proudly went home with their treasures in hand and smiling faces.

* Time was always given when questions like these arose, no matter what formal subject was scheduled. The President would take charge and a lively discussion ensue. The teacher guided these discussions. Every subject was integrated with or revolved about this Science book—Spelling, English, Reading, Penmanship, Art, Arithmetic, Health, Geography, Civics—and the children were interested because they worked in these subjects as a Club and not a class. There was a steady growth in the love of living things and a sense of responsibility to conserve wild life as is made evident in the preface which begins, "This book was made so that we as well as any who read it will be interested and more considerate of Plant Life."

AN EVALUATION OF CERTAIN GENERAL SCIENCE TEXTBOOKS ON THE BASIS OF THEIR CONTRIBUTIONS TO HEALTH EDUCATION

JEROME R. HURD
Clintondale, New York

PROBLEM

The teaching of health may be regarded as an important aim of education at all grade levels. It is recognized that there is an unlimited possibility of correlating health education with general science. This is especially significant when we realize general science may be the pupil's most important source of health training. Apparently authors of general science textbooks have taken cognizance of these facts and as a result have included varying amounts of health information in their books.

The purpose of this study was to evaluate ninth-year general science textbooks on the basis of a detailed outline of health topics. This is in contrast to the method used whereby analyses are made on the basis of the number of pages devoted to a small number of topics. Specifically, the objectives were:

1. To produce a more comprehensive and significant method of determining the health content of general science textbooks by:
   a. Developing a weighted method of determining the amount of health information they contain.
   b. Evaluating them in terms of items of health information.
   c. Eliminating the possibility of counting the same information twice.
2. To show the trend in the amount of health information in certain ninth-year general science textbooks published at the same time and at five-year intervals of time.
3. To find the nature and amount of health information contained in certain representative ninth-year general science textbooks.
4. To prepare a list of reference information for those desiring to teach health units in the ninth grade.

THE SOURCES

Ten books [1] were selected for the study. Two books were chosen at intervals approximately five years, beginning with 1915 and ending with 1935. One series of four books published by a particular publishing house over a period of 16 years was chosen. The remaining six books were chosen at random.

1. Caldwell, Otis W., and Eikenberry, William L. *Elements of General Science.* Boston: Ginn and Co., 1914. 308 p.
2. Clark, Bertha M. *An Introduction to Science.* New York: American Book Co., 1915. 494 p.
3. Caldwell, Otis W., and Eikenberry, William L. *General Science.* Boston: Ginn and Co., 1918. 404 p.
4. Van Buskirk, Edgar F., and Smith, Edith L. *The Science of Everyday Life.* Boston: Houghton Mifflin Co., 1919. 416 p.
5. Caldwell, Otis W., and Eikenberry, William L. *Elements of General Science.* Boston: Ginn and Co., 1926. 600 p.
6. Pieper, Charles J., and Beauchamp, Wilbur L. *Everyday Problems in Science.* Chicago: Scott, Foresman and Co., 1925. 600 p.
7. Caldwell, Otis W., and Curtis, Francis D. *Introduction to Science.* Boston: Ginn and Co., 1930. 658 p.
8. Hunter, George W., and Whitman, Walter G. *Problems in General Science.* New York: American Book Co., 1930. 688 p.
9. Wood, George C., and Carpenter, Harry A. *Our Environment: How We Use and Control It.* Boston: Allyn and Bacon, 1934. 792 p.
10. Powers, Samuel R., Neuner, Elsie F., and Bruner, Herbert B. *Man's Control of His Environment.* Boston: Ginn and Co., 1935. 753 p.

[1] The books selected, in the order of their copyright dates, are:

The preface of each of these books indicated that the book was designed as an introductory course in science or as the third course in a three-year sequence of general science. Further, numerous studies of general science textbooks [2] were consulted to aid in determining what books were considered representative in the field.

THE METHOD

To determine what was health information it was continually necessary to refer to authoritative sources or resort to personal judgment. Four sources proved particularly valuable in determining the limits of health education. These sources were the studies by Strang, Meier, Chappelear, and Commonwealth of Pennsylvania referred to above.

An extensive outline was developed containing twenty-three major health topics. These topics are similar to those found in the above publications. Under the major topics, in outline form, numerous minor topics were listed. The nature and organization of the minor topics was determined by the textual information and its relation to the organization of health subject matter by the authorities consulted. The minor topics directly indicate the amount and nature of health information and henceforth will be called items of information. Irrespective of its place in the outline, each item of information is given a value of one.

The outline was prepared along the left-hand margin of cross section paper, and symbols designating the textbooks were placed in a horizontal column at the top of the paper. Whenever an item of information appeared in a textbook it was checked in the column of that particular book. At the same time the page on which the information appeared was recorded. The outline was partially revised once and the books were rechecked on the basis of this revision. In the construction of the outline special care was taken to include all important health information in a logical manner and to prevent the repetition of items of information.

FINDINGS

It would be impossible to reproduce here the outline of 3,414 health items and thus show in detail the wide variety of health information included in the different textbooks. For example, thirty-two different diseases are discussed by the ten books. Only three of these diseases are treated by every book.

Table I summarizes the informational material included in the general science textbooks. It shows topically the perfect score * and the number of items contained in each book; it gives the total number of items for each topic, for each book, and for each five-year period. In addition, the table gives the ranking of all topics in the textbooks.

* The perfect score is the total number of items of information possible for each topic.

[2] These nine studies were used:

1. Chappelear, Claude S. *Health Subject Matter in Natural Sciences.* New York: Bureau of Publications, Teachers College, Columbia University, 1929.
2. Downing, Elliot R. "An Analysis of Textbooks in General Science." *General Science Quarterly* 13:509–516; 1928.
3. Harap, Henry, and Persing, Ellis C. "The Present Objectives in General Science." SCIENCE EDUCATION 15:477–497; 1930.
4. Heieman, Ailsie M. "A Study of General Science Textbooks." *General Science Quarterly* 13:11–23; 1928.
5. Klopp, W. J. "A Study of the Offerings of General Science Texts." *General Science Quarterly* 12:236–247; 1927.
6. Leker, W. R. "The Articulation of General Science with the Special Sciences." *General Science Quarterly* 10:158–173; 1925.
7. Meier, Lois. *Health Material in Science Textbooks.* New York: Bureau of Publications, Teachers College, Columbia University, 1927.
8. Strang, Ruth. *Subject Matter in Health Education.* New York: Bureau of Publications, Teachers College Columbia University, 1926.
9. Commonwealth of Pennsylvania, Department of Public Instruction, Harrisburg, Pennsylvania. *Tentative Course of Study in Health Instruction for Secondary Schools.* Bulletin 61, 1931.

TABLE I

SUMMARY OF HEALTH INFORMATION IN GENERAL SCIENCE TEXTBOOKS

	Number of Items												
		1915		1920		1925		1930		1935			
Topic	Perfect Score	CL	CE	VS	CE	PB	CE	HW	CC	WC	PNB	Total	Rank
Food	695	279	220	343	230	306	257	367	252	490	124	2,868	1
Disease	528	136	88	163	115	234	148	270	126	238	159	1,677	2
Air and Sunlight	301	86	67	126	73	115	159	150	103	187	101	1,167	3
Water	88	44	49	52	48	58	48	51	58	69	19	496	5
Psychology	138	5	..	2	..	7	..	15	18	76	99	222	15
Cleanliness	102	23	11	33	16	41	27	40	25	76	..	292	11
Waste Disposal	64	13	20	15	21	24	27	31	19	28	42	240	14
Clothing	89	32	..	54	3	56	4	32	41	31	..	253	12
Safety	193	18	3	44	10	35	35	112	34	139	33	463	6
Eyes	140	50	5	36	5	94	60	79	50	99	48	526	4
Stimulants—Narcotics	134	30	2	49	45	45	46	51	58	72	23	421	7
Exercise — Posture	128	7	10	11	16	36	37	53	15	46	78	309	10
First Aid	175	21	..	35	..	56	14	79	36	115	..	356	9
Circulatory System	98	9	41	50	42	32	42	33	33	65	70	417	8
Elimination of Body Waste	63	14	11	22	23	38	21	28	19	56	11	243	13
Heredity	63	6	22	15	21	6	21	42	22	38	13	206	16
Ears	76	2	..	25	..	..	38	31	25	30	31	182	17
Mental Hygiene	70	7	5	11	5	5	10	26	10	37	13	129	20
Endocrine Glands	28	..	..	..	..	..	..	2	..	9	25	36	22
Health Laws	69	17	..	27	4	6	15	29	22	31	16	167	18
Health Organization	94	7	5	5	5	..	15	68	11	33	..	149	19
Industrial Hygiene	59	13	..	9	5	4	5	50	4	..	4	94	21
Feet	19	..	..	..	..	3	..	..	..	19	..	22	23
BOOK TOTAL	3,414	819	559	1,127	687	1,201	1,029	1,639	981	1,984	909	10,935	
YEAR TOTAL		1,378		1,814		2,230		2,620		2,893		10,935	

There is a wide variation between the perfect score and the number of items the various books have on the same topic. The difference between the perfect score and the score of individual books is likewise evident in the total book score column where the highest score, 1,984, is only 58 per cent of the perfect score, 3,414. This shows there is no great agreement among authors as to the extent and nature of topical development.

The data in the table show a general agreement as to the health topics included in the science books. The majority of authors omit "Endocrine Glands" and "Feet." Thirteen topics are treated by all ten books while ten topics are omitted by one or more books. The education for parenthood was not included in any of the textbooks examined.

The five topics which are given the most extensive treatment ranked in order of total items of information are: "Foods," "Diseases," "Air and Sunlight," "Eyes," and "Water." If the five leading topics in each book are tabulated, we find that there is almost complete agreement among authors as to the relative importance of "Foods," "Diseases" and "Air and Sunlight." There is less obvious agreement on "Eyes" and "Water." "Stimulants and Narcotics," "Safety" and "First Aid" each appear twice among the first five topics.

A definite trend in the health information content of general science textbooks is shown in the table. The total for the different years shows a constant increase over the period of years, 1915–1935. It should be pointed out that a tendency for an in-

crease in the size of the books during this period was not taken into account.

If the items of information for each topic are tabulated under the five five-year intervals, instead of under the authors, as in the table, trends in health information on various topics can be seen. "Disease," "Safety," and "Ears" are the only topics with an uninterrupted increase from 1915–1935. There is less information on "Water," "Clothing" and "Industrial Hygiene" in 1935 books than in 1915 books. Other topics have more information in 1935 than in 1915.

The summary ranking of the total health items in the ten general science textbooks indicates disagreement among authors as to the amount of health information a general science textbook should contain.

The Caldwell series of books shows a constant increase up to 1925, the 1930 book having less information (981 items) than the 1925 book (1,029 items). In 1930 Curtis replaces Eikenberry as one of the authors. The series of books, 1915–1930, shows an uninterrupted increase in information on "Clothing," "Stimulants and Narcotics" and "Health Laws." The first three books, 1915–1935, show a continuous increase in the topics "Food," "Disease," "Air and Sunlight," "Cleanliness," "Waste Disposal," "Clothing," "Safety," "Stimulants and Narcotics," "Exercise and Posture" and "Health Laws." Apparently there is a change in the health policy by the authors of the 1930 book.

In conclusion, it would seem that later general science textbooks contain more health information than the earlier books. There is, on the whole, agreement among authors as to the health topics which should be included. There is little agreement as to the specific nature or amount of health information that should be included. It is doubtful that a study of most general science textbooks would give the pupil adequate health information.

DESIRABLE MATHEMATICAL KNOWLEDGE FOR SCIENCE STUDENTS

JAMES H. ZANT

Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma

It is perhaps false to assume that certain definite mathematical knowledge must be acquired as a prerequisite to success in the study of science. It is not hard to find instances where students come to a course totally unprepared from the traditional point of view but who have good minds and good habits of work and with the help of these qualifications are able to attain outstanding success. We feel, however, that this would not happen in the usual case.

The causes of failure are also many. A common practice among teachers of all levels is to blame student failure on something that the preceding teacher failed to teach properly. Thus a student cannot learn physics because he doesn't know enough mathematics. He cannot learn junior high school mathematics because he hasn't learned sixth grade arithmetic, *et cetera*. . . . Causes of failure are much more varied than that. However, the fact that failures in science are often attributed to unsatisfactory work in mathematics should be both a compliment and a challenge to the high school mathematics teacher. We feel proud to think that so many teachers think our subject necessary for the proper pursuit of science. On the other hand it involves a responsibility to

determine just why so many students of science in high school and college seem to lack the proper proficiency in mathematics.

In the discussion of this problem, I would like to propose four questions:

1. Are teachers who say they cannot teach physics or other sciences properly because the pupils are poorly trained in mathematics merely "passing the buck" and trying to cover up some fundamental weakness of their own?
2. Are students now in college and high school as well prepared as formerly?
3. Do we need mathematics for the study of science and if so what kinds?
4. How does the present day or traditional course in mathematics meet these needs?

The answer to the first question varies with teachers and pupils. Too many of us are prone to explain our failure on the basis of what the student lacks. It is easier to say that the student fails chemistry because he doesn't know algebra than it is to make a more careful study of the problem and do a better job of teaching. For example, the words "positive" and "negative" appear more than 200 times in one well known physics textbook. Mathematics teachers expect pupils to understand positive and negative in connection with the number system. However, in physics this idea is extended to "positive and negative poles," "positive and negative charges," "positive and negative ionization," and the like. Can one expect the idea of "positive" and "negative," obtained by the study of algebra, to transfer to all of these without some definite teaching effort? Science teachers are likely to assume that pupils understand all of these things just because they have used "positive" and "negative" in the limited sense pertaining to elementary algebra. A more careful study would probably convince them that the fundamental idea must be extended carefully before the student can use it adequately.

It is surprising how many teachers use the excuse that former teachers have not done their work properly. It is also surprising to see the different viewpoints of teachers at different levels. A secondary teacher blames the intermediate grades teacher, the college teacher blames the high school teacher—and so it goes. One teacher in this district had occasion to test some pupils in the junior high school on the subject matter of arithmetic and, when she found that they were deficient in some of the operations with decimals and percentage, she did not say that the pupils had not been taught properly in the fifth and sixth grades, but said, "Why these pupils did not know the work on decimals which we had taught them one or two years before." Perhaps this is the key to much of the lack of knowledge of the fundamentals. Perhaps we should not expect many of the pupils to remember, but rather recognize the fact that some of these things must be re-taught. Is this too much for the science teacher to do? Could more and better science be taught if the essential mathematics were re-taught during the science class?

As stated above, there is no answer to the question of whether teachers are right in blaming failures in their courses on something which the pupil doesn't know. It is stimulating and enlightening for each of us to stop and consider each time we are tempted to make such a judgment, and ask ourselves seriously whether or not the pupil's failure is due to lack of essential knowledge or to poor teaching on our part.

The second question may be stated more to the point by asking: Are students of today worse than they were ten or twenty years ago? Many college teachers will answer "Yes" without hesitation. They recall their own classmates, and themselves, when entering college and decide that the quality of the crop has been lowered considerably. It is a fact, of course, that the large increase in enrollments of high schools and colleges has brought into these schools students who in former years would be working. In many cases these people belong to the mentally less capable group. If this is true, the general average

has undoubtedly been lowered. However, during this period there have been distinct advances in methods of teaching, in materials for teaching, and in the training of teachers. It should be possible for the teacher to do a better job than teachers did twenty years ago. This tendency has been more notable in the science fields than in most of the others. Many of us can remember when our smaller secondary schools made no pretense of having a science laboratory. Pupils read about experiments and perhaps observed a few evidences of scientific laws in nature, but that was the extent of experimental science as presented to them.

So while our student body may be somewhat lower intellectually than formerly, it has attended schools which have much more adequate equipment than formerly, and has been taught by teachers who not only have better training but much more of it than formerly. One cannot say for sure that they are better or worse.

At the Oklahoma Agricultural and Mechanical College we give a series of entrance tests each September. For example, in September 1939 we gave the Cooperative Elementary Algebra test. This test covers the algebra through quadratics, or what is ordinarily studied in the ninth year. The test was standarized in such a way that a score of 50 represents that score which was made by the average high school student upon completion of first year algebra. Only those students who were taking a curriculum which includes some mathematics were required to take the test. This is a somewhat select group, but large numbers of them had had only one year of algebra, usually in the ninth grade, so that much had been forgotten. Taking everything into consideration we frankly did not expect the group to be any better than the average high school student at the end of the ninth grade. However, the average of the group was ten points higher on the scale than that of the ninth grade students. We have had too little experience with the tests to make any sweeping generalization, but it does raise a doubt about the college freshmen of the present day being much weaker than they were 20 years ago.

The third and fourth questions: Do we need mathematics in science courses? and, How do our present day or traditional courses meet these needs? will be discussed together. The need of mathematics in the study of science varies with the science course, the text in use, the teacher, and other factors. Physics uses much more mathematics than biology. Some texts will use mathematical terms and symbols frequently which another text may not use at all, or only occasionally.

We shall discuss three topics which cause trouble for science pupils: symbols, facts and skills, and general processes or methods of procedure.

Symbolism. A frequent criticism by science teachers of a student's mathematical knowledge deals with his ability or lack of ability to use symbols. For example, a physics teacher introduces the formula $s = \frac{1}{2}gt^2$ and discovers that his pupils cannot solve for g. Numerous other examples could be cited. This represents a real problem for both the science and the mathematics teacher, and one which can be solved only by a cooperative attack.

What does the situation involve? It might be stated like this. In mathematics we use a certain fairly simple and very definite symbolism:

1. We represent unknown expressions by certain letters near the end of the alphabet. Too often we use x, y, and z almost exclusively.
2. We represent arbitrary constants, when they are used at all, by letters near the beginning of the alphabet, i.e. a, b, c, *etc.*
3. We have quite a definite set of geometric symbols; a line is represented by AB or a, a triangle by ABC (always capital letters), an angle by three points $\angle$ABC, one capital letter $\angle$A or a small letter $\angle$X.

This involves an attempt to make mathematics both definite and simple. It often defeats its own purpose and makes the

subject mechanical and thus of little use in other fields.

What happens in a science class? Often science teachers seem never to have heard that mathematics should be simple and definite. Their actions as regards symbols go far beyond what is taught in mathematics books. These actions, judged largely from what appears in textbooks, might be summarized under three heads:

1. They use many of the symbols used by the mathematics teacher, i.e. $+$, $-$, $=$, $\angle$, x, y, π. There is little reason for students who have passed mathematic courses having trouble with these.

2. They use other symbols equally good but different from those used in the mathematics classroom, i.e. v_0 for initial velocity, v', v_f, ϕ for an angle; $27 \cdot 10^8$ for 2,700,000,000, and the like.

3. They also use some symbols which might be termed mathematically unsound or even contradictory. For example, lb/in^2 does not mean a fraction, as any mathematician would infer, but pounds of pressure per square inch; H^+ does not mean a zero exponent or 1 as it means in mathematics, but indicates that hydrogen has neither a positive or a negative charge. Other instances might be cited.

The question now is what shall we do about it? Apparently both mathematics and science teachers have supposed that if a student learns to use the symbolism of algebra, he can use the symbolism of science. The dissatisfaction expressed by science teachers indicates the falsity of this assumption. Many students perfectly capable of stating the square of a^2x^3 would be unable to state the square of τ^2, τ^3. There are four hundred symbols used in the three college subjects; physics, chemistry, and statistics. No one would advocate including all of these in the high school mathematics course.

A cooperative effort by both science and mathematics teachers might take the following form:

1. Standardize, and possibly reduce, the symbolism of science. There seems to be no good reason why all physics teachers should not use the same symbol for initial velocity, at least in the elementary courses. This might well include some revision of symbols with the idea of eleminating contradictions between science and mathematics symbols. In each field then, a symbol like C^{-2} would have the same meaning. Mathematicians would be the first to recognize and admit that mathematics is a purely arbitrary science, and that any symbol which anyone wants to use is admissible as a part of the mathematical system as long as it is so defined and limited that its meaning and use are clear. However, it is also important to have the mathematical system and symbols as simple as possible to carry on the work in hand. This is the reason for pointing out that symbols of science and mathematics should be made as simple as is consistent with the work which has to be done.

2. When these symbols have been standardized as much as is practical, the mathematics teacher should make an effort to include as many of these as possible in the mathematics classes. This would probably mean introducing quite a few more symbols than we now use as mathematics teachers. It would also mean introducing explanatory material to clarify the meaning and use of symbols. Necessarily this should be simple enough for the pupils of this age to understand. Incidentally, such a scheme would probably make the mathematics course much more meaningful than it now is. Pupils would much more likely see some use for the subject and would have a much better attitude toward learning it. However, most of those symbols which involve subject matter beyond the student's level should not be introduced merely so he can become familiar with them.

3. This leads to the third suggestion—that those necessary symbols which cannot be made meaningful to the mathematics student must be presented and taught by the science teacher. There will doubtless be a number of these. Too often, I think, the science teacher expects the pupils to get the meaning of these incidentally, or assumes that because a student has used x's and y's in algebra, he should be able to use ϕ's and R_e's, and the like, in physics. Many times the science teacher doesn't even realize that he is introducing or using new terms.

Facts and Skills used in the sciences include those of both algebra and geometry. As in the case of symbols, these facts have a much wider range than is usually observed in high school mathematics. For example, many simple facts of geometry are used, but we also find use in science teaching for the fact that for small angles the arc and the chord are about equal. Linear equations used in physics are likely to take the form

$$\frac{.001118}{e} = \frac{167.88}{8}$$

or

$$\frac{1}{60} + \frac{1}{q} = \frac{2}{30}.$$

Is it any wonder that even fairly good students of algebra have trouble with their physics?

On the other hand, strange as it may seem, we teach much more of some topics in algebra than the students of physics need. For example, from three to eight methods of factoring are almost universally taught in high school algebra courses, yet Congdon [1] found that only one case of factoring was used anywhere in a well known college physics textbook. Incidentally this was the simplest type of factoring, that of removing a common monomial factor. Only special cases of quadratic equations appeared; not a single problem or discussion in the book called for the use of the quadratic formula or completing the square. In the case of similtaneous linear equations not one appeared in the form usually stressed in secondary and college mathematics, i.e.

$$\begin{aligned} x + 3y &= 7 \\ 2x - 4y &= 9 \end{aligned}$$

Those found were of the form

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{5}$$

$$\frac{p}{q} = \frac{1}{6}$$

or

$$p + q = 15$$

$$\frac{p}{q} = \frac{1}{2}$$

"The nearest approach to this type of problem that is generally found in high school algebra textbooks is the following:

$$\frac{6}{x} + \frac{12}{y} = -1$$

$$\frac{8}{x} - \frac{9}{y} = 7$$

Such problems are not numerous in algebra. They are usually considered as unusual or exceptional problems, or even as 'catch' problems in which the trick is to eliminate *without clearing of fractions.* The physics problems illustrated above are not quite in this form. On the contrary, it is necessary to *clear of fractions,* or at any rate it is more convenient to clear of fractions in one of the two equations." [1]

The above instance and also the one regarding factoring illustrate a very important practice in physics. Many mathematical facts and skills needed in physics are not very difficult but they are *unusual.* The similtaneous equations given above would not be classified as hard, but the high school pupil has had very little experience with this sort of thing. Factoring is limited to common nomonial factors, but they are expressions of the form $\frac{1}{2}$ wR — $\frac{1}{2}$ wr = $\frac{1}{2}$w(R–r) or

$$\text{povo}\left(1 + \frac{t}{273}\right) = \frac{\text{povo}}{273}\left(273 + t\right)$$

and the like.

Changing the form of an equation in a physics discussion so that it makes a handy and workable formula seldom involves anything more than fundamental principles that have been taught in algebra classes. Many of these conversions consist in changing the subject by merely dividing or multiplying both sides of the equation by some letter or letters.
For example,

given: $\frac{i_1}{I} = \frac{r_2}{r_1 + r_2}$

show that: $i_1 = I\left(\frac{r_2}{r_1 + r_2}\right)$ or given:

$G\frac{Mm'}{R^2} = m'g$

show that: $GM = gR^2$ or given:
$IE = I^2R + Ie$

show that: $I^2 = \frac{E - e}{R}$, and the like.

Probably most (mathematics) teachers will say that their pupils have been trained in the fundamental steps into which these problems can be analyzed, and that therefore, they will have no difficulty in simplifying the equations. The facts are that although pupils have had

[1] Congdon, A. R. *Training in Mathematics Essential for College Success in Physics.* New York: Bureau Publications, Teachers College, Columbia University, 1929.

[1] *Ibid.*

experience with the elements involved in the simplification of these expressions, they have very seldom, if ever, met these particular and peculiar combinations of simple elements in a situation so complex as many of these. Certainly they have not met them with this variety of capital letters, small letters, Greek letters, primes and subscripts.

Some formulas of this sort are intrinsically more difficult. For example, change

$$\frac{R-p}{q-R}=\frac{p}{q} \text{ to } \frac{1}{p}+\frac{1}{q}=\frac{2}{R}$$

or

$$1=\frac{R^2}{r} \text{ to } R=\frac{r}{3}, \text{ etc.}$$

The steps to these problems are always included in the science books so pupils are not expected to solve them without aid.

The remedy of the situation is essentially the same as the one suggested for the treatment of symbols. That is, make the science courses as nearly standard as possible in regard to algebraic manipulations and skills used, include as many of these as possible in the mathematics courses, and put the responsibility of teaching the others on the science teachers.

General Processes and Methods of Procedure. The Report of the Mathematical Association of America states

> The primary purpose of the teaching of mathematics should be to develop those powers of understanding and analyzing relations of quantity and of space which are necessary to an insight into, and control over, our environment, to an appreciation of the progress of civilization in its various aspects, and to develop those habits of thought and of action which will make these powers effective in the life of the individual. . . . Continued emphasis throughout the course must be placed on the development of ability to grasp and to utilize ideas, processes, and principles in the solution of concrete problems rather than on the acquisition of mere facility and skill in manipulation.[1]

The above statement expresses the true purpose of the teaching of mathematics and also much of the purpose of the teaching of science. It is just here that the teachers of the two subjects can cooperate to the most advantage. Many of the manipulations of algebra can only take on their true meaning when properly applied, as is done in science problems.

Such processes as changing from one unit of measure to another by means of a known ratio, the resolution of a problem into two or more component parts, each part being dependent on the preceding part, and the discarding of irrelevant data are some of the many ideas and principles which we hope to develop by means of mathematics and science.

> Perhaps the truest values in mathematical training lie in training in processes rather than in facts and specific skills, since the transfer of facts and skills is far more problematical than the transfer of general processes.[2]

Ordinarily problems requiring such processes are unreal to the algebra student. Many times they are omitted entirely. If such problems are also a part of the physics course, pupils are much more likely to understand the problems and see some value solving them. However, this would necessitate teaching physics and mathematics at the same time. While this is done in some schools, it is often not possible to do so. Actually pupils study physics one to three years after completing algebra. At the time they study algebra they do not know enough science to understand many of the science problems. When the science problems are met, the student finds that much of the algebra has been forgotten, and that there are many new symbols and different equations involved. We know that it is not possible to expect the student to know all of these things or to remember all of those which have been learned previously. The science teacher must assume some of the responsibility for re-teaching and for presenting new material regarding the applications of processes and

[1] *The Reorganization of Mathematics in Secondary Education* (edited by J. W. Young), 1923.

[2] Hedrick, E. R. "The Reality of Mathematical Processes." *Third Yearbook* of the National Council of Teachers of Mathematics. New York: Bureau of Publications, Teachers College, Columbia University, 1928.

principles as well as symbols and formulas needed.

In considering the mathematics needed in the teaching of science one thing is often overlooked by the science teacher. Mathematics is not a mere tool for the sciences, as important as that aspect of the subject is. We teach mathematics for other purposes than to enable pupils to understand scientific principles and problems. So, though we may discover that certain phases of high school mathematics are not useful to students of science, this is not a sufficient reason for omitting it from the course altogether. These phases of mathematics may have value from the standpoint of some other subject or may be considered valuable in themselves.

CONCLUSION

Science, especially physical science, and mathematics have many things in common. They need each other. The student of science needs the concise symbolism of mathematics, he needs the manipulative skills which mathematics fosters, and more than anything else, he needs the principles and means of procedure which are inherent in mathematics as a mode of thought. On the other hand, mathematics becomes, more often than we like to admit, a purely mechanical and meaningless subject to our students. One of the causes of this is that students of mathematics are not shown the many practical ways in which the subject may be applied, One of the most fruitful fields of application is in the sciences. I feel confident some cooperative scheme such as has been outlined in this paper is entirely feasible and probable. Some work has been done in this direction already. A few experimental schools are teaching integrated courses in mathematics and sciences, but it seems probable for a long time the courses will be separate. This is more likely to remain the rule in college than in the secondary school. A cooperative scheme which would be usable at present in the practical situation would be devised on the assumption that the courses in mathematics and science are to be separate courses, and in many cases, to be taught by separate teachers. As separate courses they will have separate sets of aims, though many of these will be identical. But none of these things should prevent us from getting together and solving our common problem cooperatively.

MEASURING THE CONTRIBUTION OF THE NINTH GRADE GENERAL SCIENCE COURSE TO THE DEVELOPMENT OF SCIENTIFIC ATTITUDES

GEORGE WESSELL
Kenmore, New York

In the past few years a new philosophy of science teaching has appeared, a philosophy which sets forth three major aims or goals: (1) the development of a scientific attitude of mind on the part of the pupil, (2) the ability to use a scientific method of procedure and (3) a fund of information so that the pupil is prep. red to cope with the modern scientific world. While we do not accept this philosophy as the final formula in science teaching, we do observe that it is gaining ground rapidly and that science courses are being organized about these objectives. The question which arises, however, is: will this philosophy work? Does our science instruction contribute to the attainment of these objectives?

The only evidence we have in the matter of developing scientific attitudes is entirely subjective and not at all quantitative. This

evidence is entirely the personal opinion of science teachers who state that during the course of a single year they have observed a change in certain attitudes of their pupils. How great this change is, or in what elements of the scientific attitude this change has been greatest, is not known. While this evidence is of some value to the investigator it is not sufficient to support the contention that science courses reach this goal adequately. To obtain more objective and quantitative data as to the contribution of a specific science course to the development of this attitude, this study was made. To attain this end an experiment was set up in the ninth-year general science course at the Kenmore Junior High School, Kenmore, New York.

In this experimental set-up, a single group of pupils was selected. This group contained 147 ninth year pupils, 114 of which were completing the ninth year science course and 33 were beginning the course. This group was tested at the beginning of the term with one form of scientific attitude test devised by the author and at the end of the term with the second form. The tests themselves were constructed from popular applications of scientific principles as found in modern advertising. The elements of the scientific attitude measured by this battery of tests were: (1) freedom from superstitions, (2) ability of the pupil to base his judgment on fact, (3) ability to distinguish between a fact and a theory and (4) the cause and effect relationship. All tests employed in this experiment had been given actual trial at East Bloomfield High School, East Bloomfield, New York, in order to discover the range of the test, suitability of various items for measuring scientific attitudes and all general administrative weaknesses, before actual use at Kenmore.

In order to check the factors, aside from the general science course itself, which might contribute to the development of scientific attitudes, the following procedures were adopted. A group of 40 pupils who had no previous science training was selected. This group consisted of pupils who had transferred from other schools where no science course is found below the ninth grade and also the pupils who had transferred from local parochial schools where no seventh and eighth grade science is taught. This group was given one form of the scientific attitude test and the results were to be used as a check on the out-of-course factors that might contribute to scientific attitude development. In addition to this control group, one group of 29 pupils were selected from the eighth grade, one of 25 pupils from the eleventh grade, and one of 26 pupils from the twelfth grade. These groups were, likewise, given one form of the scientific attitude test in order to check the factor of attitude development in a single grade in a limited time. The third check employed in the experiment was in the form of a questionnaire which was submitted to the experimental group of 147 pupils. The purpose of the questionnaire was to offer some check on out-of-school as well as out-of-course influences on scientific attitude development.

During the interval (one school term) between pre-tests and end-tests, no effort was made to give the pupils special instruction in order to develop scientific attitudes. The course was conducted in the same manner as previous years. Textbooks and reference materials were handled in the customary manner without any intention to direct pupils or focus attention on attitudes. At no time during the course were situations introduced which were similar to those found on the tests. At no time were pupils given any idea of the true nature of the test.

The results of the end-tests and pre-tests are presented in Table I—A. Means for each section of the tests are likewise presented in the same table—B.

In analyzing the above results, the only statistically significant difference in means

TABLE I

A. MEANS, STANDARD DEVATIONS AND DIFFERENCES BETWEEN MEANS OF SCIENTIFIC ATTITUDE PRE-TEST AND END-TEST SCORES, MADE IN A STUDY OF THE CONTRIBUTION OF 9TH GRADE GENERAL SCIENCE TO THE DEVELOPMENT OF SCIENTIFIC ATTITUDES.

	Pre-Test			End-Test			
Group	N	Mean $\sigma_{av.}$	S.D.	N	Mean $\sigma_{av.}$	S.D.	D/$\sigma_{diff.}$
9A	114	57.80 ± 1.29	13.85	114	65.30 ± 1.81	19.37	3.98
9B	33	51.25 ± 1.95	11.20	33	56.40 ± 1.88	10.80	2.28
9B *	40	52.88 ± 2.09	13.25	33	56.40 ± 1.88	10.80	1.21

* Group of pupils with no previous science training.

B. MEANS FOR SECTIONS OF THE SCIENTIFIC ATTITUDE TESTS, BOTH PRE- AND END-TESTS.

9A Group Pre-Test			9A Group End-Test			
Section of Test	N	Mean	Section of Test	N	Mean	Diff.
A Judg.—Fact	114	11.30	A Judg.—Fact	114	11.75	+ .45
B Cause Effect	14	12.75	B Cause—Effect	114	13.45	+ .70
C Fact—Theory	114	29.10	C Fact—Theory	114	28.75	— .35
D Superstition	114	5.85	D Superstition	114	12.35	+ 6.50

9B Group Pre-Test			9B Group End-Test			
Section of Test	N	Mean	Section of Test	N	Mean	Diff.
A Judg.—Fact	33	11.26	A Judge—Fact	33	11.00	— .26
B Cause—Effect	33	12.30	B Cause—Effect	33	13.24	+ 1.06
C Fact—Theory	33	24.75	C Fact—Theory	33	23.50	— 1.25
D Superstition	33	4.60	D Superstition	33	9.40	+ 4.80

is found in the 9A group. The smaller gain for the 9B group may be due in part to the much smaller population or sample. Undoubtedly the influence of practice effect on the means was considerable as indicated by the fact that some of the scores on the end-tests showed abnormal gain. An analysis of the gains on different sections of the tests seems to reveal that greater emphasis is placed on "Basing Judgment on Fact," "Fact-Theory" and "Superstition" in the A work. The greater gain seems to have been made on Section D, "Superstition" in both A and B courses.

Since no reliable criterion exists in the field of scientific attitude measurement by which the validity of these tests may be determined only indirect methods can be

used. The two forms of the tests were given to eight science teachers at the Kenmore High School. They were requested to answer the items and to submit criticisms of the items, the sections and of the entire test. Their reactions were tabulated and the keys for scoring were made from the majority agreement on each item. The consensus of opinion was that the test seemed to measure what they understood by the scientific attitude.

Correlation between scores of duplicate forms of the tests produced a coefficient of $.61 \pm .04$ and an index of reliability of .78 over a single grade range. The group used in the correlation was a 9A group of 114 pupils with a variability of 57.85 and 65.30. The correlation between I.Q.s derived from the Terman Group Intelligence Test and scores of these scientific attitude tests were $.53 \pm .048$ which is rather similar to the .41 of the Noll Scientific Attitude Test and the .66 of the Downing Scientific Thinking Test. Correlation between scores of these tests and scores of the Kansas City General Science Test of Information (7th–9th grade range) revealed a coefficient of $.61 \pm .0432$.

The attitude tests employed in this study seem to measure something besides intelligence or mere information since the higher the relationship between these factors the less need there is for a separate test or measure.

The contribution of the ninth-grade course to this attitude development is evident from the facts but this contribution is relatively small when one compares the means of the group with previous science training with that of the group without such training. It is small too when we consider the expectations of science teachers and curriculum makers. It is difficult to state, also, how great this contribution is in comparison with the other factors such as out-of-school influence, maturation and other courses of study where quantitative data is not available.

From the study it is quite evident that the general science course content does not permit the proper emphasis on scientific attitudes. Experiments and demonstrations as now organized and directed do not offer sufficient opportunity for pupils to display attitudes of mind. Pupils are not forced to make judgments and then revise them or discard them on the basis of facts brought to light in the scientific method. Teachers are not directing their pupils to display proper scientific attitudes or to employ a method of thinking as much as they are to the accumulation of facts or information.

The author feels that this study has merely pointed the way to a more complete investigation of these "mind sets" which play such an important part in our conduct. With this problem of scientific attitudes properly solved, the science teacher and curriculum-maker may look forward to more effective science teaching.

THE USE OF MOLD AS THE MEANS FOR DETERMINING THE WHOLESOMENESS AND SANITATION OF CERTAIN FOOD PRODUCTS

JACK R. HOLLINGSWORTH

Head of Science Department, Swedesboro High School
Chemist, P. J. Ritter Co., Bridgeton, New Jersey

In the attempt of high school biology teachers to give their pupils experiences of a nature that will be of definite value to them in later life, the writer feels that more mention should be made of the use which the government authorities make of the presence of mold as an indication of the wholesomeness of certain foods; a fact which is overlooked by most biology texts.

The writer examined a number of high school biology texts and found little reference to the fact that the Food and Drug Administration, The Agricultural Marketing Service (which agency passes on the wholesomeness of food purchased for our armed forces), and most state departments of Health and research laboratories use the presence or absence of mold in accepting or rejecting certain food.

In order to determine if a certain product comes within the limitations as set up by the Food and Drug Administration a method known as the "Howard Mold Counting Method" is used. This method was developed around 1913 by Howard,* Chief Microscopist of the Department of Agriculture, and is recognized by the government as the official method for mold determination.

The apparatus needed for applying this method includes "Howard Mold Counting Cell" or slide; a slide which has been developed to hold a definite amount of sample; a microscope capable of 100 diameters magnification and having a draw tube which can be adjusted so as to produce a field of 1.382 diameters.

Briefly the method consists in the examination of 50 fields of the slide (in actual practice 25 fields are counted on two different slides so as to give a more representative sample) and recording as positive every piece of mold seen that is more than ⅙ of the diameter of the field. The number of positive fields reported is then multiplied by 2 and the answer reported as a percentage of 100 fields.

In dealing with tomato products (where this method is widely used) the Federal Government allows a maximum of 40 per cent for catsup and 20 per cent for tomato juice.[1]

As the writer has described it this method seems relatively simple. However in actual practice there are a great many complicating factors encountered by one applying this method. The usual manner for one to become a "mold counter" [2] is by serving an apprenticeship of about two weeks in a laboratory recognized by food manufactures. There one is taught to recognize the various types of mold filaments (as they appear under a magnification of 100 diameters) and to distinguish between mold and certain parts of the product. For example, in counting tomato products the novice frequently mistakes cell walls and small particles of fibro-vascular bundles for mold.

* For a brief history of this method and a more detailed description see Bulletins No. 16 and 28 of the U. S. Department of Agriculture or Bulletin No. 27 of the National Canners Association.

[1] Previous to the season of 1940 the tolerance on tomato juice was 25. In 1940 it was reduced to 15 per cent and in 1941 the "mold count" was raised to 20 per cent where there are many indications that it will remain for the next few years.

[2] It might be of interest to college personnel officers to know that large numbers of college and medical students are hired and trained every summer to do this type of work by the larger canneries (whose packing season ordinarily takes place during the college summer vacation).

Mold as it appears under 100 diameters is quite different from that seen in most biology texts (as illustrated by A in Figure I). In mold counting only the filaments (mycelium) (see B of Figure I) are

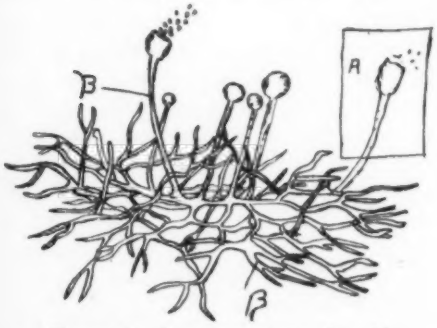


FIGURE 1.—A common type of mold, consisting of spores and mycelium.

counted and not the spores. Biology texts ordinarily illustrate and emphasize the spore formations rather than the filaments.

The reason that the Government uses the presence of mold to indicate the purity of the product is not due to the fact that mold is harmful (mold ordinarily has little or no toxic effects), but is due to the fact that there is a definite correlation between the percentage of mold present and the amount of the harmful agents such as bacteria and yeasts.

Bacteria and yeasts cannot be counted without a magnification of less than 400 diameters and working under this high power throughout a working day, is very tiring to the eyes and frequently results in lowered efficiency of the technologist.

The growth of mold is likewise an indication of "dirty" conditions which are the same conditions which harbinger the growth of the various types of harmful bacteria.

For these reasons the various governing agencies have worked out standards based on the presence of mold as the determining factor in indicating the wholesomeness of the various food products and the sanitation under which they are produced.

As the complexity of city life increases and more and more people are getting less and less of the fresh food products, and as home canning is on the wane, it becomes increasingly important that the manufacturers of canned products continue to produce wholesome foods and more important that the average citizen have some idea of the controls used to insure his safety.

It is very easy for a biology teacher to demonstrate this method to a group of pupils. Simply use an ordinary glass slide on which is placed a drop of tomato catsup (as much as can conveniently be held on the blade of a scalpel) and cover with the cover glass and place it under the low power of the microscope. Allow the members of the group to examine the slide, recording all filaments noted.[3] This count will not be accurate but the pupil will have a better and different understanding of the chief method used by the regulating agencies in his behalf.

It has been the writer's experience in teaching in a community where the farmers send large quantities of tomatoes to canneries, that those farmers who realize why their tomatoes are rejected, tend not to be as intolerant as those farmers who do not realize what definite standards the cannery must meet.

The writer believes that both the city and the country dweller should be acquainted with this method as it indirectly is affecting the welfare of a large majority of our people; and as the trend toward "canned products" increases will affect more and more people every year.

[3] The writer realizes that they will miss the smaller types of mold, and count foreign material as mold.

LET'S REALLY TEACH CONSERVATION FOR NATIONAL DEFENSE

EVELYN F. KNOPPEL
2110 West 35th Street, Chicago, Illinois

A little girl asked for an expensive doll for Christmas. When her mother explained that they could not pay Santa Claus for everything she wanted, the child glibly and revealingly replied, "Let Daddy write out a check, he's got lots of them." This story is typical of the American youth's idea that "there is much more where this came from." He fails to realize, and we have not stressed the fact strongly enough, that some natural resources such as oil, gas and coal *are* exhaustible.

The schools have become very much aware of the need for teaching conservation in the elementary school but little will be accomplished in the direction for which they are headed if the instruction is not changed.

It is true that the science teachers faithfully put across such terms as "erosion," "natural resources," "rotation," "water cycle," and "soil conservation" but there is not a carry-over into everyday life. The child leaves the classroom with a feeling that something should be done, but *he* is not the one to do it. This is the time when the child should have placed before him the ways in which he can apply what he has learned.

Many American children have every material thing they desire in abundance, so that they think conservation means unnecessary hoarding and denial. Their families are so financially fixed, according to the childish standards, that they do not need to deny themselves anything. Thus, to other failures, we are adding that of not teaching the value of money.

We, as the teachers of the citizens and wage earners of tomorrow, have a big job ahead of us. Let us begin with lessons of conservation in the school and home which affect the child's daily way of life. In the primary grades, conservation of school supplies can be interestingly taught. How many wastebaskets are "overflowing" at the end of the school session? I wager to say a majority of the schools have this occurring day after day, and yet it goes unnoticed. This is an opportunity for the teacher to tell how paper is made from trees; what materials, machinery and man power is necessary, and the varied uses of paper. She can also raise the question: "Do you get your money's worth when you throw away paper that has hardly been used?" The same method can be used in regard to the pencil, chalk, crayon, eraser, and art supplies. The children will soon become conscious of, and interested in, the origin, the use, and the value of the materials.

In the intermediate and upper grades, we can include everyday problems along with the course of study's prescribed "dosage" of conservation, which is remote from the child's daily needs. The alert teacher will study the manufacturing, agricultural, financial and social problems of the neighborhood in which she is teaching, and draw general conclusions as to their relationship to national defense. She will then formulate a question-guide sheet for the pupils which cannot help but make them conscious of their wastes. This sheet can be used hand in hand with the science course of study.

For example, when the seventh grade class is studying Electricity, the guide sheet may be as follows:

1. How do we produce the electricity which we use? Would you like to be one of a committee of five to make plans for a visit to a public utilities electrical substation where a worker can explain to us the process of generating electricity, and the way the electricity is brought from the sta-

tion to the homes, schools, offices, factories, *et cetera?*

2. Keep a record, for a week, of the number of times you entered a room which had a light burning when no one was using the room.
3. Keep a record, for a week, of the number of times you entered a room in which a radio was playing when no one was using the room.
4. After comparing your records with those of other pupils in the class, what suggestions can you give for the conservation of electricity?
5. What natural resources are necessary to manufacture an automobile battery?
6. The University of Illinois college paper, *The Daily Illini,* printed an Associated Press article on July 13th, 1941 entitled, "Columbia Motorists Get Automobiles Inspected." The article states:

"Fifty-two District of Columbia motorists received today a sample of what may be in store for automobile drivers throughout the East due to the shortage of gasoline in this area.

A special testing device showed that fifty of the automobiles were using excessive quantities of gasoline. 'Red stickers' were issued against their operators and they were given 10 days in which to make mechanical adjustments.

It was all a part of a campaign by Interior Secretary Ickes, the defense petroleum coordinator, against waste of gasoline. . . . Meanwhile, he instituted a conservation program here.

It calls for fewer stops by buses, less cruising by taxicabs, the elimination of weekend deliveries by trucks, carrying home small packages (to) reduce store delivery operations, and sharing the car with others on regular trips such as to and from work."

After having read this article, would you think it is important that our automobiles function properly? Why? Can you add any suggestions to this conservation program? Make a gasoline conservation program for our section of the country. Is there a relationship between the conservation of gasoline and the conservation of electricity as used for national defense? Bring newspaper articles to verify your answer.

7. Keep newspaper accounts, such as the one stated above, of the government's appeals for conservation of natural resources and products, noting which sections of the country are warned. Is our state directly named as needing immediate conservation? If so, what should we do about it? What can we do about it even if we are not directly warned?
8. Is electricity one of the things to be conserved? Why?

When the fourth grade class is studying "The Work of Flowers" the guide sheet may be as follows:

1. Since we know that flowers make seeds, why is it a poor policy to pick the best flowers in our gardens for bouquets?
2. How does a flower garden help to prevent soil erosion? Is erosion a problem in our neighborhood?
3. What fruits can you name that grow on trees of our neghborhood? Would we have these fruits if we picked the flowers, or trimmed off the branches when the tree did not require trimming? Why?
4. How do flowers help in making of honey?
5. Why do we have greenhouses and commercial florists?
6. Why do we have laws prohibiting us from picking the wild flowers?

The remedy, then, for this situation with which we are faced, during this crisis, and for years to come, is not to disregard the seriousness of this problem from even the child's point of view, hoping that he will better understand it when he is older, but to experiment with it now.

Let us adjust the teaching of conservation and the importance of national defense to the level of the maturity of the child being taught, and make it meaningful in the everyday experiences of *all* children.

Abstracts

GENERAL EDUCATION

HOPKINS, L. THOMAS. "Seniors Survey the High School." *Teachers College Record* 42: 116–122; November, 1940.

This article is based on interviews by the author of approximately 1,000 high school seniors. In answer to the question, "In the light of your four years of experience, what suggestions do you have for improving the high school?", three recommendations upon which there was general agreement were: (1) the staff of the school be composed of persons who will view pupils as human beings and who will be willing to meet them and their problems on a basis of sympathetic understanding and mutual helpfulness, (2) the curriculum be changed to include subjects having greater value, interest, and immediate use for them than those now taught in school, and (3) they be given an opportunity to share in the management of the school.

—C.M.P.

CROSBY, MURIEL. "Curriculum Reconstruction and Community Resources. Education Comes of Age." *Educational Forum* 5:99–104: November, 1940.

The article reports a study of the extent to which some schools are using the community as a source of enrichment and enlightment: the author contends that there is a definite need for greater use of the community in the development of children.

—C.M.P.

EFRON, ALEXANDER. "Differentiated High Schools." *The Educational Forum* 5:57–69; November, 1940.

In this article, the author contends that our new guidance program must involve a specialized education, not by means of differentiated curricula within a particular school, but through specialized schools in which pupils with common vocational interests may have opportunity to concentrate on a more comprehensive and thoroughgoing preparation for their common vocational objective. —C.M.P.

ANONYMOUS. "What People Think About Youth and Education." *N. E. A. Research Bulletin* 18:188–218; November, 1940.

The material assembled in this Bulletin is based on interviews with 3,819 persons—an educational Gallup poll. Attention was paid to obtaining a true random sampling as to geographical section, income groups, age groups, sex, urban-rural, education, and parental status. Some results: seventy-three per cent do not think education is overemphasized, eighty-five per cent think young people today are getting a better education in school than their parents got, seventy-two per cent think youth should discuss controversial topics, sixty-seven per cent think teachers should discuss controversial topics, thirty-nine per cent think high school programs are planned for both those who go to college and those who do not, and thirty-four per cent said for college only, nineteen per cent say not enough money is spent for education, forty-seven per cent said "about right," and fourteen per cent said "too much." Several other findings are reported also. —C.M.P.

JONES, VERNON. "A Proposed Educational Plan for National Defense." *School and Society* 52:473–477; November 16, 1940.

The author suggests the following areas that should be considered by schools as important phases of national defense: (1) natural resources, (2) manufacturing, agriculture, trade, transportation, banking, insurance, (3) population—immigration; numbers in various occupation, (4) unemployment, (5) standards of living, (6) the modern American's inheritance from the past, (7) selected biographical material, (8) special problems of youth, (9) special study of and projects centering around state and national holidays, (10) freedom of press, radio, worship, travel, speech, etc., (11) freedom of study and research (colleges), (12) minority groups, and (13) use of music, dramatics and the visual arts to give an emotional tone to desirable attitudes and behaviors.

—C.M.P.

MARTIN, THEODORE D. "Ethics for Teachers." *Journal of the National Education Association* 29:233–234; November, 1940.

This article presents the N. E. A. Code of Ethics adopted in 1929. Divisions are: (1) preamble, (2) relations to pupils, (3) relations to the profession, (4) relations to associates, (5) securing a position, (6) salaries and commissions, (7) testimonials and contracts, and (8) problems for study and discussion.

—C.M.P.

CLARK, HAROLD F. "Thrift and National Welfare." *School and Society* 52:414–417; November 2, 1940.

Two basic factors determine the economic welfare of any country. The first is the quality of the capital plant which is brought about by the savings of the people. The second is the quality of the trained workers which is brought about by the saving and capital accumulations. When these basic elements are adequately attended to, a high level of welfare is possible.

Thrift and saving is necessary for national welfare. A nation continually spending more than it saves will wreck its economy. It is vitally necessary that every school in the land shouuld discuss saving and thrift at great length.
—C.M.P.

BIGELOW, KARL W. "The Future of Teacher Education in America." *School and Society* 52:441–446; November 6, 1940.

Teacher education of the future will have greater emphasis on social understanding and the understanding of child development, more attention to the planned provision of significant first-hand experience, a greater integration of such experience with the study of books and with classroom activities, an increased intimacy between professors and prospective teachers, and a larger degree of participation by the student in planning and carrying out his own education. More attention will be paid to art. Far from resulting in less mastery of subject-matter, learning and teaching will be more effective. Motivation of the learner-who-is-to-become-a-teacher will be powerfully increased, and the career of teaching will have a far more challenging meaning.
—C.M.P.

RUSSELL, WILLIAM F. "No Educational Maginot Line." *Teachers College Record* 42:91–98; November, 1940.

This article is a section of the Report of the Dean of Teachers College for the academic year ending June, 1940. It analyzes the possible reasons for the puzzling and sudden and complete collapse of France. Dean Russell makes a plea that we not build an educational Maginot Line. "You cannot defend yourself by sitting behind a wall. You cannot wait for the enemy to attack. The surest defense is a strong offense." —C.M.P.

ANONYMOUS. "Democracy and Education in the Current Crisis." *Teachers College Record* 42:99–115; November, 1940.

This manifesto prepared and approved by members of the faculty of Teachers College, Columbia University, should be read by all American citizens. The manifesto points out the gravity of the present situation, the assets of our nation and the meaning of democracy. *A Creed of Democracy* lists sixty aspects of democracy. (Single copies may be obtained free by writing to the Bureau of Publications, Teachers College.) —C.M.P.

KLAPPER, PAUL. "The Role of the Educator in the Present War Crisis." *School and Society* 52:641–645; December 21, 1940.

In the present war crisis educators must: (1) "teach the positive rather than the negative aspects of democracy, the creative rather than the preventive forces of democracy, (2) revive or popularize the concept embodied in the gospel of sacrifice, and (3) reappraise the educational practices that have been taught us these last twenty years." —C.M.P.

THORNDIKE, ROBERT LADD. "Proposed Research into the Stability of Measured Intelligence." *The Advanced School Digest* 6:34–36; December, 1940.

The author proposes that research make use of the vast amount of accumulated results of past testing to study the stability of measured intelligence. There would seem to be a wealth of material for beginning such research.
—C.M.P.

SYMPOSIUM. "In-Service Training of Rural Teachers." *The Phi Delta Kappan* 23:121–172; December, 1940.

Editorial comment included: (1) Rural Education Trends by Julian E. Butterworth, (2) A Three-Point Program by Roscoe Pulliam, (3) Modern Rural School by A. F. Elsea, and (4) In-Service Training by Agnes Samuelson. Articles include: (1) Survey of In-Service Training by E. A. Collins, (2) A Philosophy and a Program by Lois M. Clark, (3) Experimental In-Service Projects by Iman E. Schatzmann, (4) New York State Program by Helen Hay Heyl, (5) Virginia State Program by Richard E. Jaggers, (6) An Illinois Teachers College Program by Dwight L. Bailey, (7) A Michigan Teachers College Program by William M. Robinson, (8) Special Extension Courses by Knute O. Broady, (9) Civil Service in Indian Schools by R. M. Tisinger, (10) Aid from the Correspondence Center by Rex Haight, (11) Function of Teachers Meetings by Howard A. Dawson, (12) A County Program in Virginia by Albert L. Bennett, (13) A County Program in Michigan by Fred C. Fischer, (14) Cooperative Program of Supervision by A. Winfield Trainor, (15) Board Members Grow in Service by Henry J. Otto, (16) An Educational Service Program by Wallace D. Orsnby, (17) Materials Bureau—A Cooperative by Marie McIver, and (18) School Transportation Costs by Otis A. Amis. —C.M.P.

HILL, WILHELMINA. "Workshops: Their Values and Problems." *School and Society* 53:39–44; January 11, 1941.

This article presents something of the history of the workshop movement, a summary of workshop values, some problems of workshops, and some of the implications for teacher-education in general. —C.M.P.

GWYNN, J. MINOR, AND GRUHN, WILLIAM T. "Requirements for Master's Degrees for Students in Education." *School and Society* 53:93–96; January 18, 1941.

This is the resumé of a questionnaire study based on replies from 29 institutions. A few of the findings reported: (1) at more than half of the institutions no foreign language is

required, (2) no thesis is required at more than half of the institutions. Most of the schools not requiring a thesis substitute either seminar papers or additional course work or both, (3) The semester hours required for graduation range from 24 to 30, and (4) at most institutions graduate students in education may take courses in more than two fields.

—C.M.P.

CONGER, N. "Selecting Courses and Materials for the Education of Teachers." *School and Society* 53:20–23; January 4, 1941.

This article may be summarized in the following statements: (1) changes in the curricula for the education of teachers during the past century have been characterized principally by the multiplication of courses through division of older courses, (2) little effort has been made to apply to the construction of these curricula the principles that students are taught to apply in the construction of curricula for lower schools, (3) a professional school should formulate a philosophy of education for itself, (4) the institution should determine as fully as possible the personality traits it expects to try to develop in its students, and (5) it should define specifically the attitudes, skills, and habits it proposes to set up in its students, together with the areas of knowledge it proposes to cover.

—C.M.P.

SYMPOSIUM. "How to Judge a School Broadcast." *Educational Research Bulletin* 19:523–542; December 18, 1940.

School broadcasts may be judged on the following bases: (1) educational value—seven criteria: social significance, historical perspective, integration of learning, cultural understanding, unusualness of presentation, democratic values, and accuracy and validity; (2) clarity and comprehensibility, and interest and appeal to listeners. —C.M.P.

LOVE, L. L., AND MCCABE, J. E. "Evaluation of a Faculty Advisory Program for Freshmen." *Educational Research Bulletin* 19:483–488; November 20, 1940.

This article evaluates the freshman advisory program of the College of Education, Ohio State University for the autumn quarter, 1939. The phase of evaluation considered was that of the effectiveness of the advisers indicated by the students themselves. Thirty advisers and 700 students were involved. Student reactions indicated that the advisers had been of genuine help to them, although there were great variations in effectiveness. —C.M.P.

FAULKNER, DONALD. "Generalization through Condensation: A Research Technique." *Educational Research Bulletin* 19:491–493; November 20, 1940.

The author describes the technique of generalization through condensation—a technique developed and used by W. W. Charters in "ascertaining the traits which characterize excellent teachers." The process is essentially that of classifying or grouping together similar statements, thus reducing their number and permitting them to be handled more conveniently.

—C.M.P.

WILLIAMS, JESSE FEIRING. "Fairy Tales and Reality: An Essay on the Relation of Physical and Health Education to National Defense." *School and Society* 53:33–39; January 11, 1941.

Health education in schools has three major lines of effort: health surface, healthful living in the school, and health instruction. There should be a definite, well-planned program in physical education in the elementary schools, in junior and senior high schools, as well as school camps. Values of the letter are especially emphasized.

—C.M.P.

WATSON, GOODWIN, AND FLASER, EDWARD M. "Education for Critical Thinking." *The Advanced School Digest* 6:29–33; December, 1940.

The article summarizes some of the studies that have been made in critical thinking. Valuable illustrations of what can be done in science are offered by Downing, Davis, Curtis, Noll, Moore, Hoff, Zapf, and Zyve.

—C.M.P.

BOSSING, NELSON L. "The Problem of Articulation between Secondary and Higher Education." *High School Journal* 24:155–164; April, 1941.

After a brief introduction emphasizing the implications to education of the changed relationship between secondary school and college since the establishment of the early academies and public high schools, the author points out some factors which have operated to change these relationships, but which are still not reorganized by many. Some of these are democratization of education through tax-supported institutions, changing theories of the nature of learning, recognition of the psychological basis of individual differences, and changing nature of the secondary school population. The author closes by raising the question as to whether the high school or the college should do the adjusting necessary for closer articulation, and offers evidence to support the thesis that the high school must organize to meet its general function of service to the citizen as a whole, and suggests "the necessity of a reorientation on the part of higher education. Henceforth, its point of focus must be "How can the college and university best articulate with the democratically functioning high school?"

O. E. Underhill.

SCIENCE EDUCATION

SIMMONS, MAITLAND P. "Publicizing General Science." *School Activities* 12:224–225; February, 1941.

The author maintains that high school boys and girls should be taught self-reliance, application, and the thrill of an accomplishment well done. Projects in general science afford an excellent means of doing this. The article gives a detailed description for a science project carried out in the author's class.

—C.M.P.

BLAKESLEE, ALBERT FRANCIS. "Ideals of Science." *Science* 92:589–592; December 27, 1940.

Modern civilization is, in large measure, the product of science. Science has been a great emancipator. Strictly speaking the ideal of science is the search for truth. Cooperation and tolerance are other ideals of science.

—C.M.P.

HENDRICKS, B. CLIFFORD, AND SMITH, OTTO M. "Better New Examinations from Old." *Journal of Chemical Education* 17:583–586; December, 1940.

This article reports a plan to make better chemistry examinations through a polling of examination questions from many different colleges, assembling them in a central depository, determining their difficulty and differentiating ability, and classifying and duplicating them for ready availability for use by teachers in service. Nine examples of making better test questions are included.

—C.M.P.

ANONYMOUS. "Science Has Not Failed Man; Man Failed to Use Science." *Science News Letter* 39:29; January 11, 1941.

According to Professor A. J. Carlson of the University of Chicago there are three outstanding causes for the failure of modern science to influence human drives and conduct measurably. These failures are: (1) prevailing education, from infancy in the home on through college, is largely education by dictation—indoctrination rather than education by understanding the why and wherefore through experimentation, (2) many scientists all too readily abandon the scientific method of thinking as soon as they are outside their own speciality, becoming as emotional and prejudiced as any non-scientific person. They get caught at this inconsistency by the man in the street, who thereupon weakens in his faith in science, and (3) man has a tremendous resistance to new ways of thinking and new ways of life. Hence he resists science which is, after all, a comparatively recent thing.

—C.M.P.

TAYLOR, L. W. "Chemistry Instruction for Purposes of General Education." *Journal of Chemical Education* 18:10–14; January, 1941.

This is the report of the A.A.A.S. Committee on the Improvement of Science Instruction for Purposes of General Education. It summarizes the retuurns of a questionnaire to college chemistry teachers. Seventy-three persons believe and 136 do not believe that the present introductory course in chemistry is satisfactory for the non-specializing student.

—C.M.P.

HINTZ, MILVIN A. "A Modern Biology Program for the High School." *The American Biology Teacher* 3:48–51; November, 1940.

The author discusses the present status of biology, the best types of courses, and the plan he uses in the South Milwaukee, Wisconsin, High School. Here, all students are required to take biology, and the students are somewhat sectioned according to ability.

—C.M.P.

GALBREATH, J. W. "An Interest Survey in Biology." *The American Biology Teacher* 3:58–61; November, 1940.

In the first part of the article, the author points out the differences between *interest* and *curiosity*. In the second half of the article, he describes an experiment carried out in his own classes in which about 425 biology students were given a list of biology topics and asked to indicate their choices. About one-half of the students were just beginning the study of biology and the other half had just completed a year's course. Considerable differences occurred between the two rankings. Microscopic study and first aid ranked first with beginning students. Heredity ranked first with those completing the course, whereas it ranked 18th with the beginning pupils.

—C.M.P.

BINGHAM, N. E. "Maturity in Urban Living." *The Clearing House* 15:195–199; December, 1940.

This article reports a ninth-grade integration of science and social problems carried out at Lincoln School, Teachers College. The article presents a description of ways that were attempted to meet certain specific objectives.

—C.M.P.

CRAIG, CHARLES HAYS. "Teaching Secondary-School Chemistry: A Study in Method." *Journal of Chemical Education* 17:591–593; December, 1940.

The author believes that students have difficulty in mastering high school chemistry, not so much because of the difficulty in comprehending the subject matter but rather because

of poor methods of teaching the subject. The author partially solves this difficulty by having each of his students keep a "notebook outline" of the more important ideas and principles. Results have been notably encouraging.

—C.M.P.

RICHARDS, T. T. "Pupils' Interests and the Teaching of Science." *The School Science Review* 22:119–125; December, 1940.

This is the resumé of a study involving nearly 300 boys ranging in ages from 11 to 14. Its purpose was to determine the interests of these boys as indicated from a collection of children's questions, and an examination of their spare-time activities. The two major conclusions drawn from the study are, that (1) the interests of these boys ranged over a very wide field that included the biological (little in plants, however), natural, and applied sciences, and (2) their interests were motivated mainly by curiosity and concern for practical utility.

—C.M.P.

CLARK, ROBERT C. "The Demonstration Laboratory for Biology." *The American Biology Teacher* 3:95–98; December, 1940.

The author describes the set-up and use of a demonstration laboratory in biology (for courses in college freshman biology and in high school biology). A series of laboratory problems are devised with some familiar type selected to illustrate definite biological principles. The student has access to a selected group of experiments and specimens covering the animal or plant group which is being considered. Each student makes an intense study of some phase of the problem of real interest to himself.

—C.M.P.

HICKS, LEON. "A Program for Individualizing High School Science." *The High School Journal* 24:63–65; February, 1941.

This very brief article points out the attempts to develop a science curriculum based on individualized special science projects.

—O. E. Underhill.

SHARPE, PHILIP B. "Alleged Science." *The Clearing House* 15:264–266; January, 1941.

The author raises the question as to how much bunk is being taught in high school science classes as gospel truth? There is too much blind worship of the textbook and veneration for the "authorities." Not only do science teachers often teach wrong information, but what is far worse, they often set for their pupils a shameful example of avoidance of the scientific method.

—C.M.P.

HALL, CARROL C. "Guiding the Pupils' First Steps in High-school Chemistry." *Journal of Chemical Education* 18:41–42; January, 1941.

High school chemistry pupils need more individual, specific guidance, especailly in the initial steps of the course, than they usually receive. The author recommends an informal reading and browsing session, laboratory locker inspection and equipment identification, inspection of textual materials, a laboratory inspection trip, a student self-evaluation exercise, a pupil-rating testing program, laboratory safety instruction, metric system drills, and visual aids as introductory materials.

—C.M.P.

EADS, R. A. "The Curriculum in Secondary Chemistry in Relation to the Needs of American Youth." *Journal of Chemical Education* 18:39–40; January, 1941.

Present-day high school chemistry texts are remarkably similar in content to college chemistry texts and to other high school texts. The author does not believe they are meeting the needs of American youth, but should give more attention to such units as Foods, Beverages, Soaps, Alcohols, Petroleum, and Cosmetics.

—C.M.P.

VERTREES, RUTH. "We Organize a Camera Club." *The Clearing House* 15:286–288; January, 1941.

Many practical suggestions are made for high school camera clubs. Many of these ideas are as applicable to science clubs.

—C.M.P.

SYMONDS, CLARE. "Tackling the Erosion Problem in High School Geography Classes." *The Journal of Geography* 40:30–33; January, 1941.

Although this unit has been written for and is used in a high-school geography class it would serve as useful a function in a conservation course or a conservation unit in biology or general science. An outline of the unit together with bibliography is presented.

—C.M.P.

PACKARD, LEONARD O. "Teaching Geography in 1940–41." *The Journal of Geography* 40:8–12; January, 1941.

The major thesis of this article is that today pupils do not study geography, they live it. Practical teaching suggestions are made for teaching European geography in spite of constantly shifting boundary lines.

—C.M.P.

RENNER, GEORGE T. "Educational Revision of the Wall Maps." *The Journal of Geography* 40:13–19; January, 1941.

This article enumerates many ways by which wall maps may be made much more effective educationally.

—C.M.P.

PRESTON, CARLTON E. "The High-school Science Man Replies to a Principal." *High School Journal* 24:126–128; March, 1941.

In the form of an open letter, Mr. Preston points out the need for emphasizing the social implications of Science equally with the prin-

ciples of science. Suggestions are made as to how science teachers may work cooperatively with other areas to make science and the social studies "mutually complimentary."

—O. E. Underhill.

COBBS, CARL T. "Use of Natural Science Sound Films in Primary Grades." *Educational Screen* 19:57–58; February, 1941.

An experimental and control group covering grades 1–4 inclusive, were taught three short science units. The experimental group used the Erpi sound films whereas the control group used the same materials except for the three sound films. A number of conclusions are drawn on the basis of the tests used. Statistically significant differences in favor of the experimental group were found "in nearly all instances."

—O. E. Underhill.

Book Reviews

SCIENCE TEXTBOOKS

GORDON, NEIL E., AND TROUT, WILLIAM E., JR., *Introductory College Chemistry.* New York: John Wiley and Sons, Inc., 1940. 753 p. $3.50.

This is the second edition of a widely used textbook in general chemistry. This edition has been brought up to date by the inclusion of newer theories in atomic structure, solutions, acids, bases, and so on. The treatment of these more recent theories is particularly good. Specific comparisons are made between the older and more recent conceptions.

Directions for 188 laboratory and demonstration experiments to accompany the textual material are included. Such inclusion in the body of the textual material is unusual and offers several advantages and some disadvantages. Most of the numerous references are to be found in the *Journal of Chemical Education.*

—C.M.P.

MCCRACKEN, EARL C. *Selected Physics Topics for Home Economics Students.* St. Louis: John S. Swift Company, Inc., 1939. 172 p.

This is a treatise for a course in *Physics for Home Economics* students written by the professor of that subject in Teachers College, Columbia University. A list of laboratory experiments is included in the textual material. The mathematical aspects of physics have been reduced to a minimum. However all major topics of the normal college physics course have been retained in this treatise. It would seem to the reviewer that a greater emphasis should be placed on the everyday household physics principles common to the experiences of Home Economics students.

—C.M.P.

HATCHER, W. H. *An Introduction to Chemical Science.* New York: John Wiley and Sons, Inc., 1940. 423 p. $3.00.

This elementary textbook is intended for use in a complete, non-specialist course in chemistry for students of branches of learning other than the sciences. No field of chemistry has been neglected in this cultural survey course that stresses economic features. Four phases of chemistry are treated: inorganic, organic, food, and industrial. The text may be used as the basis for a semester or a year's course. The treatment is not greatly different from the introductory treatment found in other sources covering the four major topics.

As a whole, the book seems fairly well balanced for a one year course in chemistry. The chemistry part of physical science survey courses should be somewhat different in content and emphasis.

—C.M.P.

CLARK, C. C., AND HALL, R. H. *This Living World.* New York: McGraw-Hill Book Company, 1940. 519 p. $3.25.

This is the first volume of a two-volume series, *A College Course in Science.* The book is intended to be used in biological survey courses. This textbook is based on the authors' long experience in giving general science courses in the School of Commerce, Accounts, and Finance, at New York University. However the book would seem to be suitable also for survey courses in arts and science schools, schools of education, or teachers' colleges.

The authors state in the preface that "one of the primary purposes in producing this volume, therefore, has been to treat the natural science on a sufficiently comprehensive basis to give a broad understanding of the nature of living things and the underlying principles governing their behavior and interrelationship. This basic requirement has been the building one in the selection of subject matter."

The content includes considerably more material from the physical science field, notably earth science, than will be found in most books of this kind. Much less attention is paid to the technical, biological science terminology. The style is vivid, simple, readable. The illustrations are timely and unusually good. Other commendable features are the excellent quality of paper, the readable type, and the annotated references. Undoubtedly students would enjoy reading this book as a text.

—C.M.P.

HODGDON, DANIEL R., AND SACHS, MORRIS NELSON. *Life Activities; Man's Environment; and Creative Science.* New York: Hinds, Hayden and Eldredge, 1939, 1940, and 1939. 255 p., 304 p., 533 p. $0.87, $0.99, and $1.35.

This series of general science books emphasizes the experimental approach to learning science. A very large number of experiments and diagrammatical drawings make these books unusually good reference books for all teachers of general science regardless of the book being used as a main text. Panel illustrations are used wherever possible to simplify the presentation of material. To the reviewer the textual material sometimes seems scanty, but the use of other supplementary books plus the excellent features of these books should make for an extremely good teaching combination. The supplementary reading of other texts, popular books, and science magazines would seem to be a

planned device. At the end of each unit there is a series of questions and activities under the following headings: "Things to Think About"; "Things to Do"; "Things to Find Out," and "Things to Talk About." There are also review questions and suggested readings. The first book is intended for the seventh grade, the second for the eighth grade, and the last for the ninth grade. —C.M.P.

HUNTINGTON, ELLSWORTH. *Principles of Economic Geography.* New York: John Wiley and Sons, Inc., 1940. 715 p. $4.00.

The author states that "the central theme of geography is the exploration of the part played by the lands, the waters, and the air in causing the plants, animals, and peoples of one region to differ from those of other regions. Economic Geography deals with the distribution of all sorts of materials, resources, activities, institutions, customs, capacities, and types of ability that play a part in the work of getting a living." This latter theme the author develops comprehensively in this book. The author is one of America's best known geographers.

The forty-two chapters are divided into twelve parts. There are more than a thousand charts and diagrams, and an excellent, selected bibliography. Not only will geographers and the general reader find this an excellent book, but teachers of science and science survey courses will find much up-to-date, authoritative data and information regarding minerals, fuels and power, metals, and so on. —C.M.P.

SCIENCE REFERENCE BOOKS

GAMOW, GEORGE. *The Birth and Death of the Sun.* New York: The Viking Press, 1940. 238 p. $3.00.

Those who have read Professor Gamow's *Mr. Tompkins in Wonderland* admit his ability to popularize science interestingly. This book is added proof. How did our sun come into being, why does it continue to light and heat us, and what will be its ultimate fate, and ours? These problems have always been a challenge to scientists and a source of fascinated speculation to laymen.

Professor Gamow's explanation of the sun's origin, present activity and final collapse carries him both into the world of atomic energy and into the limitless reaches of the island nebulae. The treatise indicates that astronomers recently have had to make many revisions of their ideas of even a decade ago.

The author affirms Bethe's theory as to the source of the sun's heat. The whole process may be described as the transformation of hydrogen into helium as induced by high temperatures and aided by the catalytic action of carbon and nitrogen. The sun is gradually growing hotter and will continue to do so until its hydrogen is used up. At this maximum the sun will emit a hundred times its present radiation. This maximum will be reached in ten billion years or so, after which the sun will cool off rapidly, reaching a diameter approximately that of the earth, but having a density of three million or so! But of course life on the earth will have long since disappeared as the sun gradually increased its temperature. The chances of the sun becoming a novae and quickly putting an end to earthly life are very rare—about as rare as other solar systems similar to ours.

The author presents interesting theories as to the origin of nebulae, galaxies, and a very clear, simple explanation as to the why all stars seem to be going rapidly away from us. Jupiter is believed to be the largest solid body that exists.

This is an excellent book for all laymen interested in astronomy, for a reference in physical science survey courses, and for every teacher of science.

—C.M.P.

STROMBERG, GUSTAF. *The Soul of the Universe.* Philadelphia: David McKay Company, 1940. 244 p. $2.00.

This book has already caused a great deal of comment and will probably do so for some time to come. The author is a member of the research staff of the Mount Wilson Observatory of the Carnegie Institution of Washington. The author briefly examines the fields of physics and chemistry, then devotes considerable discussion to the contributions of biology as they may throw light upon the problem at hand. He applies the Quantum Theory and the Theory of Relativity to the age-old problem of the relationship between mind and matter. In this way the author believes one can then understand the connection between the chemical and electrical processes in the nervous system and the corresponding sensations and feelings. The most startling results of this study are that the individual memory is probably indestructible and that the essence of all living elements is probably immortal. The study then leads to the inevitable conclusion that there exists a World Soul or God. Written in simple, relatively nontechnical language, this is a challenging answer to man's most challenging question.

—C.M.P.

GASKELL, AUGUSTA. *Whence Whither Why?* New York: G. P. Putnam's Sons, 1939. 312 p. $2.50.

Is there life after death? Is there a personal God who cares about man? Were we put on this earth for a definite purpose or does Science discredit the belief in God and immortality? Is it true that "crush the brain and that ends all?" This book tries to answer the problem of life

and death through an analysis of philosophy and science.

F. K. Richtmyer, late Professor of Physics and late Dean of the Graduate School of Cornell University in a lengthy introduction says, "Ever since man has existed as a thinking being he has had a longing to understand himself, the universe in which he lives—his universe as contemporaneously known—and his relation to that universe. Whence came this universe? What will be its termination? Can space and time have a beginning and an end? How did life on earth originate? Was man, unique in the animal kingdom, placed here by some Higher Power; or is he just another of the accidental happenings of nature? Is man's soul real, but necessary entity as the blood in his veins; or is it merely the creation of his mind invented to "explain" certain of his characteristics? Do trees have souls? Is man a free moral agent; or is his every act determined, perhaps in advance by some Supreme Ruler of the Universe? Whither is human society tending, upward or downward? Is there life on 'other worlds than ours'? Are plagues the 'visitations of the wrath of God'? Mrs. Gaskell's manuscript shows that she possesses a broad and correct grasp of the essential facts and theories requisite for her purpose. I infer that she has a similar grasp of other disciplines."

The above few statements from Richtmyer's introduction outlines the scope of this work. Mrs. Gaskell, well-known scientist, arrays philosophical and scientific proof for the existence of God and the immortality of the soul. Death is the departation of the soul from the body.

—C.M.P.

McEACHRON, K. B., AND PATRICK, KENNETH G. *Playing with Lightning.* New York: Random House, 1940. 231 p. $2.50.

The beginning and ending paragraph of this intriguing book are identical: "If you heard the thunder, the lightning did not strike you. If you saw the lightning, it missed you; and if it did strike you, you would not have known it." There is a strange combination of fatalism and comfort in these words, but they represent much that the average human being wants to know about lightning. This book presents the best popular treatment of lightning that is now available. Both the authors are connected with the General Electric Company. Dr. McEachron is Director of its High Voltage Engineering Laboratory in Pittsfield, Mass. He was in charge of General Electric's "Lightning Show" at the World's Fair.

Lightning has long been a mystery and in many of its aspects still is. However, we have accumulated a great deal of knowledge about it since Benjamin Franklin found electricity and lightning to be the same thing. We know its force—1,000,000,000 volts, compared to the 120 volts of our house current. We know its strength —up to 200,000 amperes instead of the 15 we use in our lights. Man-made lightning and indoor thunderbolts are explained and how lightning performs in thunderstorms. Practical information is included regarding the values and dangers of lightning rods, and the most safe and dangerous places to be during a thunderstorm—whether in the open or at home.

Playing with Lightning is recommended as an excellent book for the high school science book shelf and as popular reading for science teachers and the layman.

—C.M.P.

ZINSSER, HANS. *As I Remember Him, The Biography of R. S.* Boston: Little, Brown and Company, 1940. 441 p. $2.35.

Here is an interesting autobiography under the thin disguise of the biography of an intimate friend. It is not a chronological record of the happenings in a man's life but a running commentary on the people and events he encounters and the times in which he lives. Fourth and youngest son of well-to-do German parents, he took his college work at Columbia University where he was rescued from "the imbecile fraternity system" and Buckingham barroom by the inspiring teaching of George Edward Woodbury and by the revelations "on the top floor of Schemerhorn hall, under the reign of Edmund B. Wilson and Bashford Dean." On the advice of his teachers he went in for medicine, not to practice but to be an investigator on the track of typhus, his specialty. He traveled widely in Serbia, Africa, Russia, India, China, Mexico. He taught bacteriology in Stamford, Columbia, Harvard, Paris, and Pekin.

His comment touches a wide range of topics—the great bacteriologists he has known, world over, the peculiarities of college presidents, medical education, birth control, agnosticism, social conditions in Russia, the Luxembourg in spring, immortality, etcetera. He manifests rare insight, keen sense of humor and discriminating literary appreciation. The book is charming, never dull, at times rare. It contains many a laugh—yet, in spots, is profound. If you own it, you will mark many passages you will want to reread and ponder and you will disagree with the final statement that "R. S. was really a quite ordinary person about whom it was hardly worth while to write a book" for the book will have given you much pleasure.

Note: Doctor Zinsser died of chronic leukemia on September 4th.

—E.R.D.

COON, HORACE. *American Tel and Tel, the Story of a Great Monopoly.* New York: Longmans, Green and Company, 1939. 276 p. $3.00.

It is a fascinating story. It tells something of Alexander Graham Bell's struggles to make his invention work and of the rival instrument of Elisha Gray. It relates how the Bell Telephone Company was founded, how Theodore N. Vail guided the destinies of the rapidly growing concern. The difficulties met and overcome, the

problems that arose and were wisely solved, the staggering proportion of the present company make reading stranger than fiction.

The present assets exceed five billion dollars. The company has nearly 650,000 stockholders who own the 18,000,000 shares. At present the stock pays $9 per share annually. Forty-three of the biggest stockholders own over a quarter million shares, not a large proportion of the 18 million total. The average holding is less than thirty shares.

The A. T. and T. is a combination of over two hundred subsidiary companies that supply 16,000,000 telephone users with the most efficient service in the world. To read the book is to get a picture of capitalism at its best. It is so good, so restrained, so imbued with ideals of doing its jobs well that it is quite reassuring. The book is highly commended to citizens who want facts bearing on questions of public policy.

—E.R.D.

LANGE, DOROTHEA, AND TAYLOR, PAUL S. *An American Exodus.* New York: Reynal and Hitchcock, 1940. 158 p. $2.75.

The subtitle of this work aptly describes the content—*A Record of Human Erosion.* And it is just that—a stunning pictorial record of the covered wagon, 1939 style, bearing westward its broken human freight, from the old and tired, to the discouraged youth, toward that beckoning horizon where the blue makes hope spring eternal in the human heart.

This book consists primarily of gripping, dramatic pictures, supplemented with pertinent description and comment. The pictures are much more effective than any words could be, showing the great significance of the westward migration brought about by the human erosion in the midlands. Here is depicted America's greatest social and economic problem. Running comments from migrants placed on the inside front and back covers adds much to the striking appearance of the book.

—C.M.P.

HENNEY, KEITH, AND DUDLEY, BEVERLY. *Handbook of Photography.* New York: Whittlesey House (McGraw-Hill Book Company), 1939. 871 p. $7.50.

This is a complete photographic encyclopedia prepared by 23 specialists. Its purpose is to augment the many volumes covering elementary, specialized or purely artistic phases of the subject. This is a comprehensive reference work on photography and its technical and scientific applications, a reference book having the directness, rigor and authority found in various engineering handbooks. Yet much of the material is applicable to the initial devotees of photography. Naturally in such a treatise very few, if any, aspects of the subject have been omitted in the 30 chapters. Still, motion, color, stereoscopic, high-speed, spectroscopic, astronomic, micro, aerial, geologic, and radiography have been covered.

—C.M.P.

BARRETT, NESTOR A., AND WYCKOFF, RALPH. *How to Build and Equip a Modern Darkroom.* San Francisco: Camera Craft Publishing Company, 1940. 136 p. $2.00.

This book is especially valuable to anyone contemplating a darkroom construction—amateur photographer, professional, photography club sponsor, or science club sponsor, interested in having a dark room for science club members interested in photography. Seemingly no phase of darkroom construction has been overlooked by the authors. Both authors are amatur photographers of long experience. Mr. Barrett is also an instructor in photography.

—C.M.P.

SYMPOSIUM. *Little Technical Library Photographic Series.* Chicago: Ziff-Davis Publishing Company. $0.50 each.

The first ten books in this series have been reviewed previously in *Science Education.* This series completes the twenty pocket-size textbooks affording a well-rounded photographic education. Each book is authoritative, profusely illustrated and has been made as practical as possible. The books may be purchased collectively or singly. The titles and authors in this series are as follows:

"Outdoor Photography" by Samuel Grierson, "Indoor Photography" by Hillary G. Bailey, "Flash Photography" by Rus Arnold, "Photographing Action" by Victor De Palma, "Manual of Enlarging" by Stephen White, "Miniature Camera Technique" by Fenwick G. Small, "Photographic Lenses and Shutters" by Richard W. St. Clair, "Photo Tricks and Effects" by Jacob Deschin, "Selling Your Pictures" by Kurt S. Safranski, and "Darkroom Handbook and Formulary" by Morris Germain.

—C.M.P.

OSBORN, FREDERICK. *Preface to Eugenics.* New York: Harper and Brothers, 1940. 312 p. $2.75.

Preface to Eugenics constitutes an important addition to the field of biological and social science. Exceedingly broad in scope, a wealth of material has been included. The treatment is well-balanced, conservative, scientific, and scholarly. The author is one of the outstanding authorities in this field, having devoted years to an intense study of the field. He is a past president of the American Eugenics Society, the Population Association of America, and the Association for Research in Human Heredity.

The scope of the book may be gathered from the chapter titles: "The Significance of Genetic Inheritance," "Psychological Studies on Heredity and Environment," "Births and Deaths: The Background of Eugenics," "Towards a National Population Policy," "Eugenic Selection Under the Influence of a Favorable Environment," "Psychological Aspects of a Eugenic Environment," "Social and Economic Changes: Radical Aspects of the Eugenic Movement," and "Con-

clusion: The Significance of the Eugenic Philosophy."

—C.M.P.

PEAIRS, LEONARD M. *Insect Pests of Farm, Garden and Orchard.* New York: John Wiley and Sons, Inc., 1941. 549 p. $4.00.

This is the fourth revision of an excellent text and reference book. It is estimated that insects damage crops, including animals and stored products, to an extent of about one and a quarter billion dollars annually. Such a loss constitutes a major conservation problem.

Phases of this treatise are devoted to the structure and development of insects, classification, different kinds of control, and insects injurious to various farm crops and products. The descriptive material is supplemented with class and individual descriptions and life histories, and with numerous photographs and charts. In addition to entomologists, the book is an excellent reference for high school and college survey courses in biology.

—C.M.P.

MITCHELL, LUCY SPRAGUE, BOWMAN, ELEANOR, AND PHELPS, MARY. *My Country 'Tis of Thee.* New York: The Macmillan company, 1940. 335 p. $3.50.

In the foreword the authors say "this book about natural resources—soil, coal and oil—and the role they play in present-day United States is written for anyone not too young to think and not too old to feel."

The book is arranged in three main sections-soil, coal and oil—and a concluding chapter. Under each main section the first chapters are concerned with the present. In the third chapter, in each main section are found geologic case histories. The last chapter faces the question: "What to do about it?" and builds a national program based upon the findings of the preceding chapters. Throughout the drama of the development of the three natural resources, the following groups appear: the owners or developers, the workers, the consumers, and the government. There are 37 pertinent charts, 28 maps, and 28 full-page, timely photographs.

The book is especially recommended as supplementary reading and source material for courses in conservation, and certain units in science survey courses. Altogether the book is quite outstanding and constitutes a most valuable contribution to the field.

—C.M.P.

MATHIEWS, FRANKLIN K. *"The Boy Scouts Year Book of Wild Animal Stories.* New York: D. Appleton-Century Company, 1940. 295 p. $2.00.

Here is a book, chock full of exciting stories of adventures with wild animals—grizzly bears, mountain lions, wolves, coyotes, foxes, monkeys, tigers, leopards, lions and many more. Altogether there are twenty-four stories, each written by a well-known author. Every boy of Boy Scout age—whether a Scout or not—will thoroughly enjoy the invigorating atmosphere of the rough and rugged out-of-doors found in these delightful stories. We even suspect Girl Scouts would enjoy this book, too! It is highly recommended for the junior or senior high school science book shelf—but it will never be there, for it is most likely to be only a name and number in the card catalog!

—C.M.P.

SETON, JULIA M. *Ernest Thompson Seton's Trail and Campfire Stories.* New York: D. Appleton-Century Company, 1940. 155 p. $1.00.

One of the most outstanding men in American science recently said that he regarded Ernest Thompson Seton, the great nauralist, dean of all story-tellers. Other persons in position to know have made similar statements. The reviewer is sorry that he cannot add his own confirmation, but he has never had the privilege of hearing Mr. Seton. However, she can testify that in this book there are twenty most delightful stories such as "The Holy Grail"; "Little Otto"; the "Charcoal Burner"; "Gorm, the Giant with the Club"; "The MacKenzie River Ghost," and so on. The author, wife of the naturalist, but well known in her own right as a lecturer and writer, collected these stories and edited them. In the introduction is a very interesting essay on the art of story-telling as Mr. Seton has developed it.

—C.M.P.

HART, HORNELL. *Chart for Happiness.* New York: The Macmillan Company, 1940. 198 p. $2.00.

The present book is based on two propositions: first, that it is possible for science to measure happiness and unhappiness reliably; and secondly, that if we can thus measure, we can then move toward discovering the causal factors by means of which we can learn with more and more effectiveness to eliminate misery and increase joy scientifically. Dr. Hart, Professor of Sociology at Duke University, bases the above assumptions on the results of ten years of research at Stanford, Chicago, Columbia, and Duke universities. The author presents the euphorimeter tests to measure individual happiness in relation to effective living and working. By using the tests or chart, it is believed that one can discover the points of imperfect adjustment in one's personality and environment, and find the means of correcting them.

—C.M.P.

HOLMAN, JESSIE B. *An Easy Guide to Astronomy.* San Antonio, Texas: The Naylor Company, 1940. 235 p. $1.60.

This book is especially useful and interesting because of the classical stories and myths that the author relates about the various signs of the zodiac, about all of the major constellations and

many of the minor constellations. So often, one is at a loss to recall the myth associated with a given constellation or zodiac sign—this book is a rich source of this type of knowledge. Associated along with these stories is a vast amount of astronomical information, similar to that found in other books on the constellations. It is a good reference book for science teachers and pupils.

—C.M.P.

RICHARDS, L. W., AND RICHARDS, G. L., JR., *Geologic History at a Glance.* Stanford University: Stanford University Press. $0.25.

Geologic History at a Glance consists of two geologic charts and a sheet of explanations. Each sheet has a diagrammatic-photographic columnar section, an age column, era column, time per cent column, period column, and a major physical events column.

The charts will be of great help in geology courses and in physical science survey courses.

—C.M.P.

ATWOOD, WALLACE W. *The Physiographic Provinces of North America.* Boston: Ginn and Company, 1940. 536 p. $4.80.

This book would seem to meet a real need in its field, for there has long been needed such a treatise on the physiographic provinces of North America. It is less detailed and less technical than other similar works. Geomorphic aspects have been emphasized rather than geology. There are 281 figures which include some excellent photographs.

College physical science survey and geography teachers will find this a most useful reference text. Also, it would seem to be especially adaptable as a basal text in certain geology courses.

—C.M.P.

PEATTIE, RODERICK. *Geography in Human Destiny.* New York: George W. Stewart, Publisher, 1940. 323 p. $3.00.

The author has succeeded in writing one of the most interesting popular books in geography that has been published in recent years. Dr. Peattie says that: "Geography is the reciprocal relationship between physical environment and life—geography as a science is neither fowl, fish nor good red herring. What it is, is a correlation between sciences and it is only that. If one must classify it, call it a philosophy."

The importance to man of passes and corridors, the importance of isolation, and above all the effect of climate in producing arid and semi-arid land which made for enforced restlessness on the part of inhabitants of such regions, is graphically exemplified. Such inhabitants have been the "have-nots" of history. Often they have become nomads who "though they are always on the move, they never progress."

This book, though scientific in every detail, will be of interest to a great variety of readers. The approach to the subject of geography used in this book is new and different and holds the reader's attention from beginning to end. The book is recommended to laymen, teachers of geography, and to anyone interested in science.

—C.M.P.

HINMAN, ROBERT B., AND HARRIS, ROBERT B. *The Story of Meat.* Chicago: Swift and Company, 1939. 291 p. $1.00.

This book will serve as an excellent reference book for science classes as well as home economics classes. Laymen will find the book most interesting. It would be fine to use in connection with trips to meat packing plants. Poultry as well as beef, hog, and mutton is discussed. There is a short history of meat through the ages, the meat industry before 1860 and the meat industry since 1860. There are discussions on the main functions of the meat packing industry, classes and grades of meat, meat inspection, preservation of meat, the manufacture of sausages and ready-to-serve meats, and price determination.

—C.M.P.

PEET, CREIGHTON. *This Is the Way We Build a House.* New York: Henry Holt and Company, 1940. 126 p. $2.00.

This is a superbly illustrated and delightfully told story-picture book about the building of a house. It should serve as an excellent reference book in general science and physics courses and even in the "building materials" unit in college survey courses. The reviewer knows of numerous teachers who might profit from the reading of this book. In fact, the reviewer believes our science teaching could be made much more functional by utilizing such source materials as are indicated in this book. In many communities the building of houses is so typical an activity that it is regretable that science teachers make little or no use of what could be a vital experience.

—C.M.P.

DAVIS, ROBERT H. *Let's Go With Bob Davis.* New York: D. Appleton-Century Company, 1940. 452 p. $3.00.

Bob Davis has more than a million miles of travel behind him, and several books to his credit describing many of his adventures. In this delightful book the author depicts his journeyings through India, Ceylon, Venezuela, the Caribbean, Puerto Rico, Alaska, the Yukon, Gaspe, and Chesapeake Bay. An excellent story-teller, Bob Davis imparts to the reader his own enthusiasm and spontaneous interest in what he has seen and the people he has met. Like Harry Franck, another well-known globe-trotter, Bob Davis has an amazing talent for finding, wherever he goes the "local character" from whom he extracts an entertaining, delightful story. *Let's Go With Bob Davis* is an enjoyable vicarious, travel experience.

—C.M.P.

DAVIS, HASSOLDT. *Land of the Eye.* New York: Henry Holt and Company, 1940. 415 p. $3.00.

This is a narrative of the labors, adventures, and excursions of the Denis-Roosevelt Asiatic Expendition to Burma, China, India, and the lost kingdom of Nepal. The author has written an exciting story of the expedition headed by Armond Denis and Leila Roosevelt. Denis's major purpose was to make motion pictures. In this he was eminently successful. The experiences in Burma, along the Burma Road, and in Nepal are vividly portrayed. The expedition had the good fortune to obtain the first motion pictures ever brought out of Nepal and this book constitutes the first authentic description of this mysterious kingdom in inner Asia whose name means "the Cherished of God." Not over two hundred white persons have ever been permitted to set foot in the kingdom. Naturally, there are many things not permitted to outsiders. They found no pure Nepalese religion, but rather a mixture of India and Tibet which is purely Nepalese, peculiar to this country and none other in the world. Again one is impressed with what a strange world is this planet of ours. To anyone enjoying a thrilling story of adventure in far away places this book is highly recommended.

—C.M.P.

MASON, GREGORY. *South of Yesterday.* New York: Henry Holt and Company, 1940. 401 p. $3.00.

Mr. Mason has led over a dozen archaeological expeditions into the countries around the Caribbean. The first part of this book recounts airplane surveys of the Yucatan, looking for evidences of Maya cities. He has discovered and supervised the uncovering of several such. The second part recounts explorations in northeastern Colombia among the Kagaba Indians, cultural descendants of the Taironas. These were contemporaries of, and probably traded with, the Mayas.

It is a book of adventure, of travel in strange lands among strange peoples, with a substantial core of significant discovery, and of the meaning of his own finds as seen against a background of the accomplishments of other explorers. There are 17 pages of Maya, and 7 of Tairona bibliography. The book is well illustrated with photographs by the author. It makes good reading for the layman and if you are archaeologically inclined you will gobble it with avidity.

—E.R.D.

KEYSER, CASSIUS JACKSON. *Portraits of Famous Philosophers Who Were Also Mathematicians.* New York: Pictorial Mathematics, c/o Scripta Mathematica, 610 W. 139 Street, 1939. $3.00.

These portfolios have been acclaimed by both mathematicians and laymen for their beauty and art. Each portrait (10 by 14 inches in size, suitable for framing) is enclosed in a beautiful folder containing the biography of the subject printed in two colors. The biographical sketches are among the finest the reviewer has ever read.

Portraits and sketches include: Pythagoras, Plato, Aristotle, Epicurus, Roger Bacon, Descartes, Pascal, Spinoza, Leibnitz, Berkeley, Kant, and Peirce.

—C.M.P.

FRANCK, HARRY A. *Roaming in Hawaii.* New York: Grosset and Dunlap, 1939. 340 p.

This is another travel book by one of the world's outstanding travellers. In this book he again portrays his remarkable analytical and descriptive powers, and innumerable are the bits of information he weaves into the story of his travels in the 49th State. The Francks arrive in Hawaii at a most opportune time when Mauna Loa is putting on a vivid volcanic display. So the introduction is quite varied from what the usual visitor does and sees upon his arrival. Then follow descriptions and narrations about jaunts to places on the various islands, from the leper colony, sugar cane plantations, and pineapple factories, to Waikiki beach.

The book is an interesting supplementary reader in geography and of great value and interest to a possible visitor to these mid-Pacific islands.

—C.M.P.

MCSPADEN, J. WALKER. *Beautiful Hawaii.* New York: Thomas Y. Crowell Company, 1939. 220 p. $2.50.

Beautiful Hawaii is in some contrast to a similar book by Harry A. Franck. Like his book it is filled with wit, common sense and information, but omits much of the detailed political, economic, philosophical and other information, characteristic of Franck's books.

The author, Mr. McSpaden is an excellent writer and he gives much valuable information and many good suggestions for the initial visitor to the "Land of the Lotus-Eaters." A list of "musts," "don'ts," what to avoid, how to separate the "phoney" from the real, and the approximate costs are included.

—C.M.P.

FEDERAL WRITERS' PROJECT. *Oregon, End of the Trail.* Portland, Oregon: Binfords and Mort, 1940. 549 p. $2.50.

This guide to Oregon presents the story of the past and present in panoramic style. Outstanding geological formations, the variety of native fauna and flora, the natural resources, the economic and cultural life, and the people that make up the state, are discussed in this compendium of information about Oregon. Automobile tours are outlined in detail with all the accuracy humanly possible. About 38 such tours are described. There are a series of pertinent photographs.

This guidebook will not only serve as a useful, informational book to all residents of Oregon,

but to all prospective visitors and others interested in knowing more about a very interesting American state.

—C.M.P.

FEDERAL WRITERS' PROJECT. *Montana.* New York: The Viking Press, 1939. 442 p. $2.50.

This is a state guide book in the American Guide series. There are 9 maps and 75 photographs. These guide books represent a valuable addition to our information of the various states of the Union. And Montana, the Treasure State, is one of the most picturesque states among the forty-eight. Part I describes the general background of Montana; Part II describes the leading cities: Billings, Butte, Great Falls, Helena, and Missoula; Part III gives detailed suggestions for 19 tours. About 30 pages are devoted to tours in Glacier National Park. Much information relating to the geology, geography, resources and scenic possibilities of Montana make this a very useful and practical guidebook.

—C.M.P.

FEDERAL WRITERS' PROJECT OF THE WORKS PROGRESS ADMINISTRATION. *California.* New York: Hastings House, 1940. 713 p. $2.50.

This guide to the Golden State is one of an excellent series of Hastings House contributions to the American Guide Series. Each book offers quite a complete guide to the history, resources, and cultural backgrounds of the state. And no state surpasses California as a lure for tourists. Probably no state has as great a diversity of people, climate, scenery, and resources as has California. This guide book is represented as being the most complete California guide now available. Like the other books of the series it will long serve as a comprehensive and accurate source of information about a great American state.

—C.M.P.

WORKERS OF THE WRITERS' PROGRAM OF THE WORK PROJECTS ADMINISTRATION. *Arizona.* New York: Hastings House, 1940. 530 p. $2.50.

This is a guide to the Sunset State. Part I describes Arizona's background—its early history, architecture, natural resources, agriculture, mining resources, transportation, Indian reservations, and culture. Part II describes eleven of the state's most noted cities. Part II outlines the many delightful tours that may be taken in the state. There are numerous excellent photographs of places, peoples, and industry. —C.M.P.

WORKERS OF THE WRITERS' PROGRAM OF THE WORK PROJECTS ADMINISTRATION. *Texas.* New York: Hastings House, 1940. 718 p. $3.00.

This guide to the Lone Star State is one of the American Guide Series. It is the story of Texas —that mighty empire of the Southwest. It is the greatest state in size, in oil production, and in cotton. The textual material sketches the history, geography, natural resources, agriculture, architecture, and cultural life of the state. Fifteen cities are described in some detail. Twenty-nine suggested tours are described. Many photographs supplement the textual material. The book is interesting, informational, and comprehensive. —C.M.P.

WORKERS OF THE WRITERS' PROGRAM OF THE WORK PROJECTS ADMINISTRATION. *New Mexico.* New York: Hasting House, 1940. 458 p. $2.50.

This is a guide to the Colorful State. New Mexico today represents a blend of three cultures: Indian, Spanish and Anglo-American. Four hundred years have elapsed since Vasquez de Coronado entered its northern borders in 1540. Who does not recall the anceint cities of Santa Fe, Taos, and Acoma, the historic Inscription Rock, the scenic wonders of Carlsbad Caverns and the White Sands. Tours to New Mexico's many scenic wonders are described in some detail. Much of the history, archeology, natural resources, industry, agriculture, folklore, and culture of the state both before and after Coronado is presented.

—C.M.P.

WRITERS' PROGRAM OF THE WORK PROJECTS ADMINISTRATION. *The Ohio Guide.* New York: Oxford University Press, 1940. 634 p. $2.75.

This is a guide to the Barometer State that has sent seven native sons to the Presidency. The Guide has three main divisions. In its seventeen essays is a record and interpretation of interesting and important developments in the political, cultural, and industrial life of Ohio. Nineteen cities are given especial attention. There is detailed information about transportation, tours and a calendar of annual events, supplemented with numerous photographs.

—C.M.P.

GENERAL BOOKS

LYON, LEVERETT S., WATKINS, MYRON W., AND ABRAMSON, VICTOR. *Government and Economic Life.* Volume I. Washington, D. C.: The Brookings Institution. 1939. 519 p.

This volume is concerned with "fundamental issues of government's relations to economic life," and is to be followed by a second volume dealing with more special cases of government participation.

The four parts into which the book is divided discuss respectively, basic concepts and conditioning factors, implementation of government and

private enterprise, regulation of these enterprises, and general observations in interpretation and new developments.

Among the more specific topics are: individual enterprise, partnerships, corporations, bankruptcy, patents, money mechanisms, labor dispute adjustment, research in business control, competition in business, concerted action among workers, terms and conditions of employment, and new developments in business activity and control.

The treatment is academic rather than popular and intended for the student primarily. Historical and legal materials are drawn upon frequently to make clear the relationships of government to economic life in the past and in the present and to lead the student to a position where he may intelligently consider possibilities of changed relationships in the future. Essentially this is a research study.

—A.W.H.

MICHIE, ALLAN A., AND RHYLICK, FRANK. *Dixie Demagogue.* New York: The Vanguard Press, 1940. 298 p. $2.50.

This is a blistering array of unpublished and generally uncomplimentary remarks about some of the South's less ornamental statesmen. It really makes one seriously wonder how Democracy can function as well as it does. It would seem that the South is not only our economic problem number one but really more seriously our political problem number one. There may be a close relationship between the two, with the former actually preceding from the latter. *Dixie Demagogues* presents an economic and social background reminiscent of such books as *90° in the Shade, Forty Acres and Steel Mules, You Have Seen Their Faces,* and so on.

—C.M.P.

WILSON, CHARLES MORROW. *Corn Bread and Creek Water.* New York: Henry Holt and Company, 1940. 309 p. $3.00.

The subtitle of this book, *The Landscape of Rural Poverty,* aptly indicates its theme. The author, well-known writer and farm reporter, presents a detailed, dramatic picture of present-day rural America. The reviewer, farm-reared himself, considers this the best treatise of rural life and conditions that he has read. Based on much travel and personal observation, the author presents a sympathetic picture of the farm problem—erosion and drought, tenancy and migration, education, conservation, and relief. Although presenting no program of rural reform Mr. Wilson takes sharp issue with the theory that producing less and taking farmers off farms has or will solve our problems. America's problem is one of solving the paradox of want in the midst of plenty.

The author realistically portrays the "Little Red School House," "Lo, the Poor Indian," "Poverty on the Ocean Front," "Timber," "Beef," "Po' Folks Down South," "Drought Country," "Poverty with Plenty," (Aroostook Potato Farmers of Maine), and "Stepsons of the Corn Belt."

Surely all teachers would profit by reading this book, and as a supplementary book in Conservation courses, it would seem to be entitled to an important place.

—.M.P.

BURBANK, NELSON P. *Practical Job Pointers.* New York: Simmons-Boardman Publishing Corporation, 1940. 129 p. $2.00.

Some 600 ideas, job pointers, kinks, short cuts, and new methods of doing old jobs are described and illustrated. Practically any man will find some useful, unique idea that he can do around the house, the garage, or workshop. Science teachers doing any sort of "hammer and saw" work will find many interesting tricks and ideas here.

—C.M.P.

BABSON, ROGER W. *Twenty Ways to Save Money.* New York: Frederick A. Stokes Company, 1940. 180 p. $1.00.

The reviewer wonders if this book was not written especially for teachers! At any rate science teachers will thoroughly enjoy it. Mr. Babson, a recent candidate for President of the United States, is better known to millions of Americans as probably our most outstanding economist and writer on economic trends. Not only does Mr. Babson make suggestions for *earning* and *saving* money through planned household finance, but there are also suggestions regarding health and recreation. Surely many Americans would be better off financially, happier, and healthier if they would follow the suggestions made in this practical volume.

—C.M.P.

STONG, PHIL. *If School Keeps.* New York: Frederick A. Stokes Company, 1940. 266 p. $2.75.

If School Keeps is the autobiography of an Iowa farm boy as he struggled up to a place in the literary world where he was able to earn a living. School and sports played the most important part in his pre-literary training. Much of the story is that of rebellion, and calling Stong a rebel against much that is found in school, college or high school, is putting it mildly. Two of his greatest peeves are directed against his experiences in the S.A.T.C. at Drake University during World War I and against certain courses at Columbia University where he attempted unsuccessfully to obtain a Master's degree in English. School teaching brought him mixtures of contentment and irritations—mostly the latter. Undoubtedly he is far happier because he gave up teaching and probably the schools are better off that he made such a decision. As an author, he is witty, humorous, and interesting, but at times too critical.

—C.M.P.